

WESTERN CONNECTIONS

***Seeking Solutions to Our
Region's Environmental
Challenges***



August 31, 2001

Cover Photo: The Trans-Alaska Pipeline and the Dalton Highway bridge cross the mighty Yukon River north of Fairbanks, Alaska. Waterways, transmission lines, and transportation corridors are among the most familiar “western connections.”

WESTERN CONNECTIONS

Seeking Solutions to Our Region's Environmental Challenges

Janice M. Brown

Published August 31, 2001

**Idaho National Engineering and Environmental Laboratory
Idaho Falls, Idaho 83415**

**Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727**

EXECUTIVE SUMMARY

This report is being submitted to the Department of Energy – Idaho Operations Office by the INEEL as one of the final deliverables for the Fiscal Year 2001 Performance Evaluation Measurement Plan (PEMP). Western Connections, the proposed approach to conducting regionally relevant research as outlined in this document, fulfills Measure 4.3.2.3, which directs the INEEL to:

Develop a program to support regional, subsurface-related natural resource issues, particularly in the area of groundwater resources. The INEEL will recommend to DOE a course of implementation for such a program. Delivery of the described program to DOE will be by September 1, 2001.

The basis of validation will be the extent to which stakeholders in the Intermountain West are involved in developing the cooperative regional program for environmental sciences (focusing on subsurface issues) and the level of commitment they make to its future implementation.

The Journey for Regional Relevance

In cooperation with Dr. Mike Wright, Director of the Subsurface Science Initiative, the Ecological and Cultural Resources Department accepted the challenge of researching the nature and extent of environmental problems in Idaho, neighboring states and Alaska. The decision to have an INEEL contingent personally visit universities, government agencies, industries, and other stakeholders was based on the following objectives established for what came to be called, “The Journey for Regional Relevance”:

- To identify emerging environmental issues in the region that align with INEEL expertise and problem-solving capabilities.
- To introduce the Subsurface Science Initiative and strengthen our INRA partnerships.
- To cultivate new relationships and networks among regulators, land managers, industry, nongovernmental organizations, and the larger scientific community.

More than 200 individuals were contacted (see list in appendix) over a series of four trips and in followup consultations. They were asked to identify the more intractable environmental problems in the region where increased scientific understanding and/or improved technologies would make a lasting difference. These people offered their perspectives and enthusiasm in support of collaborative efforts that would address water quality and quantity, environmental quality and energy needs that are beyond the current scope or ability of any single company or institution. This input led to 10 conclusions.

Conclusions

1. There is a critical absence of baseline resource and trend data upon which to make scientific recommendations on environmental decisions in the North American West.
2. Even when baseline and trend data are available, there is often a lack of effective predictive tools upon which to rely for regulatory decision-making.
3. There is a critical need for new mitigation technologies and engineered remedial solutions that are less costly and more reliable over the long term.
4. Understanding groundwater-surface water interactions is becoming essential for sustainable, conjunctive water management in the arid West.
5. As development pressures increase throughout the West, so do the demands for land and water protection strategies and wastewater treatment technologies to preserve the quality of limited groundwater and surface water resources.
6. Coordinated efforts are needed to understand and effectively communicate the human health risks associated with the legacy of contaminants from military, industrial and agricultural applications that dot the Western and Arctic landscapes.
7. Responsible development of western energy resources is envisioned through a process that maximizes local, state and Tribal decision making, accesses the least polluting and most economical of resources, and minimizes environmental impacts.
8. In response to increasing development pressures in the West, creative planning strategies and system-based approaches are needed to accommodate growth while still protecting essential ecosystem functions.
9. Impartial, scientific advice and affordable, site-specific technical assistance is in high demand from local governments, state agencies, Tribes and the private and nonprofit sectors.
10. The INEEL must establish and maintain a responsive, collaborative community of scientists and engineers in order to realize its desired leadership role in environmental research and regional problem solving.

These complex environmental challenges warrant the Lab's attention as the INEEL has committed itself to serving as a “national environmental science and engineering solution provider.” As the Department of Energy's lead lab for Environmental Management, the INEEL has a clear responsibility to be an active partner in resolving the more difficult energy and environmental problems faced by western states. Once properly organized and funded to serve as a coordinator of regional research, the Lab may effectively apply its scientific expertise and engineering capabilities to environmental problem solving.

The Western Connections Approach

Western Connections is proposed as a crosscutting, directed research approach to be closely integrated with three major initiatives of the INEEL: Subsurface Science, Environmental Stewardship and Energy Resources. Western Connections projects will need to satisfy the following criteria to ensure that the involvement of a national laboratory is appropriate and warranted:

- The project falls within the scope one of the INEEL major initiatives and helps fulfill the DOE mission.
- Geographically, the project applies to challenges common to least two Western states or a Western state and country (i.e. Alaska/Canada).
- Sufficient interest exists in the project so that funding partnerships are likely.
- Sufficient expertise exists between INEEL and university partners in the region to collaborate successfully on the project.
- The problem is beyond the ability of any one industry, university or government entity to resolve alone.
- Project partners commit to participating in a rigorous peer review process and providing educational outreach as part of Western Connections.

In future years, even more participation by government, business and nonprofit sectors will be encouraged by establishing three research support teams to a) set regional priorities, b) select sound projects that maximize collaboration and c) ensure peer review.

A Western Connections Coordination Office is recommended at the INEEL to oversee the gradual implementation of this research effort, with satellite offices proposed for appropriate field locations (e.g. Alaska) to solidify and extend INEEL relationships. The following investigative, administrative and outreach functions would be the responsibility of Western Connections personnel:

- Continue to research emerging environmental challenges in the region that merit Lab and INRA university involvement in their resolution.
- Annually prepare and administer a budget for Western Connections that provides base funding for office support and grant funding for selected research projects.
- Ensure that data and information collected through Western Connections projects are properly managed and remain accessible through a new Geomatics Hub.
- Refashion the INEEL's current technical assistance program to make the service more accessible to those in need from the private and public sectors.

- Provide a symbolic "brand" or signature for Western Connections projects that distinguishes them as highly collaborative, interdisciplinary and oriented to resolving complex energy and environmental challenges.
- Ensure that Western Connections is known for its quality and regularity of public outreach and unbiased educational services, which will be provided in cooperation with existing INEEL departments.

It will take many years of positive, on-the-ground results to see INEEL's Western Connections become the widely preferred avenue for conducting collaborative environmental research in the western states. In the near term, however, it will be critical to broaden the awareness of Western Connections and affirm our commitment to applying the Lab's scientific and technical expertise to regional issues in concert with our INRA university partners. Internally, the INEEL leadership needs to:

- Demonstrate its commitment to Western Connections and sustaining the regional relationships critical to its success
- Integrate Western Connections into the INEEL Institutional Plan
- Integrate Western Connections into discretionary investment funding decisions
- Secure the resources necessary to implement the following one-year timeline:

October-December 2001

- Establish the Western Connections Coordination Office
- Form an INEEL-DOE Steering Committee
- Engage the INEEL Scientific and Engineering Fellows in Western Connections
- Convene PIs and INRA representatives to coordinate research projects & engage in summit planning
- Distribute the final Journey Report
- Establish a Web page on the INEEL Site
- Assemble a directory of INEEL scientists and engineers allied with Western Connections

January-April 2002

- Hold a series of 10 two-day topical, strategic summits at cooperating universities to enhance the awareness of Western Connections research and continue the conversations launched this year.

- Initiate FY 2003 budget discussions:

May-July 2002

- Recruit members for the Issues ID Team, Project Selection Group and Peer Review Cadre to administer the FY 03 competitive research program.
- Issue the first Western Connections newsletter

August-September 2002

- Convene the three research support teams to design and launch the FY 03 research agenda for Western Connections.

CONTENTS

Executive Summary	iii
Part I—Report on the Journey for Regional Relevance	1
1. Introduction	1
2. Principal Findings and Conclusions	3
3. Description of the Journey.....	7
3.1 Eastern Montana and Wyoming (H. Blackman, R. Breckenridge, J. Brown, R. Jones, D. Lowrey, S. Prestwich, K. Raterman, and M. Wright)	7
3.2 Western Montana/North Idaho/Eastern Washington (M. Wright, P. Wichlacz, J. McCarthy, T. Rutz, J. Brown)	13
3.3 Alaska (R. Jacobsen, R. Jones, C. Thomas, G. White, P. Wichlacz, and J. Brown)	18
3.4 Utah and Southern Idaho (B. Apel, B. Breckenridge, J. Brown, M. Hamilton, J. McCarthy, T. Rutz, M. Wright)	26
3.5 Other Consultations.....	41
3.5.1 Dr. Jim Bauder.....	41
3.5.2 David Schwarz.....	41
3.5.3 Doug McChesney	41
3.5.4 Columbia Basin Contacts	42
Part II—Western Connections, a New Approach.....	43
4. Basic Principles	43
5. Conceptual Structure and Services	45
5.1 Geomatics Hub.....	46
5.2 Technical Assistance.....	47
5.3 Educational and Outreach Services.....	47
6. Course of Implementation	48
6.1 Integration into Lab Operations	48
6.2 One-Year Timeline	48

6.2.1	October-December 2001.....	48
6.2.2	January-March 2002.....	49
6.2.3	April-June 2002.....	50
6.2.4	July-September 2002.....	50
6.3	Resource Requirements.....	50
7.	Initial Research Projects—Conceptual Outlines	51
7.1	Subsurface Challenges	51
7.1.1	Limiting the Impact of Acid Mine Drainage and Mine & Mill Wastes in the West	51
7.1.2	Reducing the Impact of Zinc on the Western Environment	52
7.1.3	Limiting Water Contamination by Selenium from Mine and Mill Operation Residue.....	53
7.1.4	Treatment of Nonaqueous Phase Liquids in Groundwater.....	55
7.1.5	Understanding the Surface-Subsurface Interactions of Contaminants in the Clark Fork Drainage, Montana.....	58
7.2	Environmental Stewardship	59
7.2.1	Contaminants in the Arctic Environment: Baseline and Trend Monitoring for Ecological and Subsistence Resources.....	59
7.2.2	A Systematic Evaluation for Optimizing Terrestrial, Riparian and Aquatic Habitats in the Pacific Northwest.....	61
7.3	Responsible Energy and Transportation Development.....	63
7.3.1	Hydrologic Challenges in Western Coal Bed Methane Development.....	63
7.3.2	A Systems View of the Electric Transmission and Energy Planning in the West.....	65
7.3.3	Greater Yellowstone WORKS (Weaving our Resources, Knowledge and Systems across the Yellowstone-Teton Region)	66
	Appendix—Contact List	69

Part I—Report on the Journey for Regional Relevance

1. INTRODUCTION

This report is being submitted to the Department of Energy – Idaho Operations Office by the INEEL as one of the final deliverables for the Fiscal Year 2001 Performance Evaluation Measurement Plan (PEMP). Western Connections, the proposed approach to conducting regionally relevant research as outlined in this report, is one of four measures needed to satisfy Performance Criterion 4.3.2, which reads as follows:

Develop preeminent subsurface science research capabilities at the INEEL consistent with the defined responsibilities of the INEEL to DOE-EM (Environmental Management). Develop science to support remediation, long-term environmental stewardship of the complex and other DOE missions. Establish peer relationships with the Inland Northwest Research Alliance (INRA), other noted universities, and National Science Foundation centers with recognized capabilities in subsurface science. Apply science developed to meet EM needs in the cleanup of the former weapon production complex to other areas consistent with the DOE mission.

Specifically, Measure 4.3.2.3 directs INEEL to:

Develop a program to support regional, subsurface-related natural resource issues, particularly in the area of groundwater resources. The INEEL will recommend to DOE a course of implementation for such a program. Delivery of the described program to DOE will be by September 1, 2001.

The basis of validation will be the extent to which stakeholders in the Intermountain West are involved in developing the cooperative regional program for environmental sciences (focusing on subsurface issues) and the level of commitment they make to its future implementation.

In the process of developing this new research approach for DOE consideration, the INEEL worked to ensure that Western Connections is thoroughly consistent with our own Institutional Plan. We believe that our vision for the future—*To be an enduring national resource that delivers science and engineered solutions to the world's environmental, energy, and security challenges*—is embodied in this endeavor, as are two of the four elements of the INEEL mission:

- Deliver science-based, engineered solutions to the challenges of DOE's mission areas, other federal agencies and industrial clients.
- Enhance scientific and technical talent, facilities, and equipment to best serve national and regional interests.

In cooperation with Dr. Mike Wright, Director of the Subsurface Science Initiative, the Ecological and Cultural Resources Department accepted the challenge of researching the nature and extent of environmental problems in Idaho, neighboring states and Alaska. The decision to

have an INEEL contingent personally visit universities, government agencies, industries and other stakeholders was based on the following objectives established for what came to be called, “The Journey for Regional Relevance”:

- To identify emerging environmental issues in the region that align with INEEL expertise and problem-solving capabilities.
- To introduce the Subsurface Science Initiative and strengthen our INRA partnerships.
- To cultivate new relationships and networks among regulators, land managers, industry, nongovernmental organizations, and the larger scientific community.

Over 200 individuals were contacted (see list in appendix) over a series of four trips and in followup consultations. They were asked to identify the more intractable environmental problems in the region where increased scientific understanding and/or improved technologies would make a lasting difference. These people offered their perspectives and enthusiasm in support of collaborative efforts that would address water quality and quantity, environmental quality and energy needs that are beyond the current scope or ability of any single company or institution. Our findings and conclusions are found in the next section, followed by a description of the four, weeklong trips that constituted the “Journey.”

The Western Connections approach to conducting regionally relevant research is proposed for implementation over the next fiscal year as described in Part II. Included are conceptual outlines for ten research projects that would be administered under INEEL’s current organizational structure, but receive the Western Connections label of distinction to ensure rigorous peer-review and help leverage internal resources. Letters of interest and/or commitment for these projects have been received that underscore the extent of outside institutional support expressed for this new endeavor.

Projects being considered for Western Connections will have to satisfy certain criteria to ensure that the involvement of a national laboratory is appropriate and warranted:

- The project falls within the scope one of the INEEL major initiatives and helps fulfill the DOE mission.
- Geographically, the project applies to challenges common to least two Western states or a Western state and country (i.e. Alaska/Canada).
- Sufficient interest exists in the project so that funding partnerships are likely.
- Sufficient expertise exists between INEEL and university partners in the region to collaborate successfully on the project.
- The problem is beyond the ability of any one industry, university or government entity to resolve alone.
- Project partners commit to participating in a rigorous peer review process and providing educational outreach as part of Western Connections.

2. PRINCIPAL FINDINGS AND CONCLUSIONS

After speaking with over 200 regional stakeholders in Alaska, Idaho, Montana, Utah, Washington and Wyoming, the INEEL team found a number of common concerns among the myriad conversations. The top ten regional findings are:

1. There is a critical absence of baseline resource and trend data upon which to make scientific recommendations on environmental decisions in the North American West.

Although lack of awareness and limited monetary resources were cited as the most common reasons for this situation, cases were cited where data were actually collected, but it either was not properly verified, found to be too old or was organized in incompatible databases. For example:

- In general, western coal reserves are not sufficiently mapped nor are deep geologic units sufficiently understood to allow adequate evaluation of re-injection potential for coal bed methane (CBM)-produced water. In most areas, site-specific analysis will be required.
- Mine sites that failed to document background levels of contaminants such as zinc or arsenic are being held accountable for violations of air or water quality standards which may not be entirely of their making (e.g. Alaska's Red Dog zinc mine).
- Intensive studies of specific Superfund sites have led to recommended remedial actions without conducting more comprehensive studies of the entire affected watershed, such as occurred in the Clark Fork drainage in Montana.

2. Even when baseline and trend data are available, there is often a lack of effective predictive tools upon which to rely for regulatory decision-making.

Agencies cited this problem for many subsurface contamination challenges, such as:

- Predicting the nature and rate of leaching through tailings or storage ponds at even the newest hard rock mines in Montana.
- Predicting what will happen to shallow aquifers over 15-25 years of coal bed methane development in Wyoming or Montana.
- Evaluating the integrity of the Trans-Alaskan Pipeline and its ability to operate for 30 more years now that the renewal of the 800-mile right-of-way is being sought.

3. There is a critical need for new mitigation technologies and engineered remedial solutions that are less costly and more reliable over the long term.

- At the Bunker Hill Superfund Site, no satisfactory method has been demonstrated to remove zinc from the leachate, resulting in continued contamination of fish habitat in the Coeur d'Alene River.

- Oil companies on Alaska's North Slope are seeking an alternative to removal of soils contaminated with hydrocarbons, favoring lower-cost treatment technologies that do not further disturb the site.
- Treatment of CBM produced water is sought by industry to reduce toxicity and make water more acceptable for surface and/or subsurface disposal.
- Capping, treating or isolating waste rock from phosphate mining in Southeast Idaho will be essential to reduce the amount of selenium leaching to groundwater.
- The need for creosote cleanups appears common to several western states where post & pole treatment operations were active in the mid-1900s. A specific example is St. Maries, Idaho.
- Designing a passive remediation solution should be the goal for the Berkeley Pit in Butte, Montana, as an alternative to active water treatment systems that currently have no end point.

4. Understanding groundwater-surface water interactions is becoming essential for more sustainable, conjunctive water management in the arid West.

- Aquifer depletion is causing allocation problems between ground and surface water users within single basins and even between states (e.g. Curlew Valley between Utah and Idaho).
- Artificial aquifer recharge programs face controversy in Idaho, Utah and Washington given water quality uncertainties and modeling deficiencies to assure that recharged water can be recovered in similar quantities.
- Isolating and monitoring contaminants at the INEEL requires a better understanding of how various tributaries contribute to the Snake Plain Aquifer. The USGS is proposing a major modeling effort in conjunction with INEEL and state agencies.

5. As development pressures increase throughout the West, so do the demands for land and water protection strategies and wastewater treatment technologies to preserve the quality of limited groundwater and surface water resources.

- Localities could use impartial technical evaluations of wastewater treatment system upgrades as development pressures increase the need for capacity.
- A model is needed for determining appropriate septic tank and private/public water well densities in proposed rural housing developments.
- Dairy and food processing industries require assistance with innovative technologies to reduce the volume and odor of nutrient-laden waste products.

6. Coordinated efforts are needed to understand and effectively communicate the human health risks associated with the legacy of contaminants from military, industrial and agricultural applications that dot the Western and Arctic landscapes.

- Long-term stewardship planning is needed for Amchitka Island in Alaska, particularly because the island lies within a National Wildlife Refuge.
- Support is needed for the interagency contaminant-monitoring program in Alaska, with a particular focus on those populations most vulnerable to increasing energy development pressures.
- Research is needed regarding the bioaccumulation of RDX by vegetables and fruit trees. This would assist the State of Utah in evaluating whether excess treatment water might be put to beneficial use in agriculture near Mapleton.

7. Responsible development of western energy resources is envisioned through a process that maximizes local, state and Tribal decision making, accesses the least polluting and most economical of resources, and minimizes environmental impacts.

- Oil pipelines require better leak detection sensors and improved burial methods for permafrost regions.
- Future modeling studies for electrical transmission upgrades in the West must analyze alternatives to conventional transmission expansion by studying: emerging transmission technologies, energy efficiency, peak load management and distributed generation located on or near the customer load.
- Tidal power companies are considering placement of facilities offshore to reduce environmental impacts
- The biogenic nature of Rocky Mountain coal bed methane gas should be objectively evaluated to determine its potential management as a sustainable resource
- Geothermal, wind and solar potential should be re-evaluated throughout the West in light of increasing electricity prices and the need for diverse supply.

8. In response to increasing development pressures in the West, creative planning strategies and system-based approaches are needed to accommodate growth while still protecting essential ecosystem functions.

- A systematic methodology and analytical framework for evaluating the relative value of land/water assets is needed for developing conservation strategies in the Northwest.
- Yellowstone and Grand Teton national parks have requested assistance with their transportation and infrastructure planning, including conversion to alternative, clean fuels.
- The feasibility of coring sediments at the bottom of the Great Salt Lake should be explored

to better understand the nature of environmental change attributable to climatic variability and Wasatch Front development patterns.

9. Impartial, scientific advice and affordable, site-specific technical assistance is in high demand from local governments, state agencies, Tribes and the private and nonprofit sectors.

- Could INEEL characterize blowout events so to accurately assess the risk associated with oil and gas development?
- How does one document if an abandoned well has closed naturally in deciding to plug or not to plug?
- Can the Lab develop advanced remote monitoring techniques for abandoned mine sites that are not accessible in winter?
- Could the lab demonstrate an efficient de-sulphurization technology for arctic grade diesel?

10. The INEEL must establish and maintain a responsive, collaborative community of scientists and engineers in order to realize its desired leadership role in environmental research and regional problem solving.

- Cultivate and maintain constructive relationships with government officials, university administrators and faculty, and an array of interests from the private and nonprofit sectors as they apply directly to the challenges in the West.
- Apply “lessons learned” from challenges faced at DOE sites to the complex energy and environmental problems that are identified in the West.
- Interpret research results to a broad audience in a manner that enhances public understanding and ensures application of peer-reviewed science to on-the-ground needs in the West.

3. DESCRIPTION OF THE JOURNEY

Significant research was required in developing the most productive itineraries possible for the INEEL personnel chosen for each trip. The assistance of a Northern Rockies consulting firm was secured to ensure access to influential officials and leading thinkers in each state. Bill Yellowtail, former EPA Region 8 Administrator and former Montana State Representative, provided essential planning assistance for visits in Montana, Wyoming and Utah. A cross-section of stakeholder perspectives was sought for each journey, resulting in meetings with local, state and federal agencies, tribal officials and staff, industrial consortiums, conservation organizations, and local citizens.

In addition to these 1-2 hour consultations, the Journey consisted of half-day visits to a dozen of the region's major universities. Informal open houses were the preferred approach used to meet faculty and graduate students, with special appointments scheduled with administrators where appropriate. Because the Journey was scheduled from late May through mid-August, attendance at these events was understandably limited, averaging 10-20 people at each campus. Sponsoring departments and institutes provided refreshments and full lunches were served in some instances. Printed materials were made available to those seeking more information on the Lab and its programs. Several hosts provided tours of their campus and/or special facilities to enhance our understanding of the unique attributes of each institution.

Critical to the success of both the university and stakeholder visits was the team's emphasis on listening. The Journey was not an attempt to "sell" the INEEL and its expertise for sheer business purposes or public relations. Rather, the trips were designed to be interactive in order to learn more about the people struggling with unparalleled growth in the region and the attendant environmental challenges. Exceptional candor was expressed in each dialogue, possible only because INEEL personnel did not make formal presentations or demand most of the talking time. By taking along senior staff who could serve as courteous and informed ambassadors from the INEEL, we conveyed our sincere interest in launching a truly collaborative, regional effort.

3.1 Eastern Montana and Wyoming (H. Blackman, R. Breckenridge, J. Brown, R. Jones, D. Lowrey, S. Prestwich, K. Raterman, and M. Wright)

Monday, May 21: The journey began at Montana State University where we were warmly welcomed and hosted for lunch by MSU President Geoffrey Gamble, Research Vice-President Tom McCoy and Dr. Al Cunningham, an enthusiastic INRA and SSI supporter. President Gamble was introduced to INRA and its important contractual relationship with the Lab, and he expressed his commitment to continue solidifying this collaborative relationship. Our tour of the MSU Biofilms Center by faculty member John Neuman was quite interesting, followed by an informal open house sponsored by the Center. About ten faculty and students stopped by over the 1-1/2 hours, which yielded some important interactions with postdocs and new faculty contacts.

Tuesday, May 22: A full day in Billings was spent learning about the Coal Bed Methane (CBM) development issue in Montana as Kevin Raterman joined us from our Fossil Energy

Technologies group. David Lopez of the Montana Bureau of Mines and Geology and consultant Bill Yellowtail accompanied the group for the day as well.

The first meeting was with Tom Richmond and Jim Halvorson of the Montana Board of Oil and Gas Conservation where we gleaned the perspective of the state's permitting organization. Due to a successful lawsuit filed by the Northern Plains Resource Council, a moratorium has been placed on CBM development pending the completion of a joint state-federal Environmental Impact Statement for Montana. Because of the halt in new drilling this leaves only 7-9 wells in Montana with at least two years of operating history, so it will be difficult to predict long-term environmental consequences from CBM play should it gain momentum in Montana. The Board of Oil and Gas will receive any documentation associated with the performance of CBM wells in Montana, so it is an important source of information on leases and overall development trends. The Board is being funded by DOE-Tulsa to develop Best Management Practices (BMPs) for CBM surface developments in both Montana and Wyoming. These BMPs would apply to leasing on state and private lands only.

Our visit to the Bureau of Land Management (Montana State Office) yielded a wealth of information and new contacts on the joint EIS under development. Chun Wong, Chief of the Fluid Minerals Branch, invited our contingent to sit in on the weekly conference call with Mary Bloom, who serves as the EIS Coordinator out of the Miles City Field Office. Other BLM staff present included Pascual Laborda and Jim Albano, plus John Wheaton from Montana Bureau of Mines and Geology.

The current schedule calls for the draft EIS to be completed by ALL Consulting (out of Tulsa) by the end of 2001, with a final out by summer 2002. While the programmatic EIS is intended to apply to all state lands in Montana, the EIS will only apply to Bureau of Land Management lands in the Powder River and Billings resource areas. Cooperators include EPA Region 8 and the Bureau of Indian Affairs. The group discussed what data sets are being generated for use in the EIS analysis and what additional research might be recommended in the document. Among those identified were:

- Soil studies identifying types most and least susceptible to produced water with high SAR (sodium adsorption ratio) - Jim Bauder, MSU with support from DOE-Tulsa
- Updated knowledge of geologic formations that might be capable of holding re-injected water without additional contamination. Existing studies are 30 years old and did not go sufficiently deep for purposes of identifying potential CBM reservoirs or targeting reinjection formations.
- Economics of effluent management being conducted by EPA Region 8, with report due in September 2001. EPA is using "best professional judgment" in interpreting available data rather than collecting new data sets.
- Local hydrological data being supplied by the Bureau of Mines and Geology from groundwater monitoring wells and past studies.

On a related note, the Montana Department of Natural Resources has provided the following list of research topics concerning CBM development:

- Develop cost-effective water treatment and/or disposal methods
- Monitoring and prediction of impacts
- Mitigation of drawdown impacts on wells, springs and streams
- Mitigation of impacts from high SAR irrigation water
- Cooperation with Indian tribes in developing CBM while mitigating impacts
- Fundamental studies of CBM generation and exploitation
- Managing CBM as a renewable resource

It should be noted that there are also ongoing conflicts between Montana and Wyoming DEQs with respect to surface water quality in the Powder and Tongue watersheds as both rivers are 303 (d) listed streams in Montana, but not upstream in Wyoming where the surface impacts are originating. As of the date of this report, Wyoming has agreed not to degrade the waters of Montana, with local Soil and Water Conservation Districts in Montana now legislatively authorized to document "water quality effects" from CBM development. The Yellowstone River Conservation District Council is currently coordinating this process.

Following our departure from the BLM office, lunch was shared with Patrick Sweeney, Executive Director of the Western Organization of Resource Councils, followed by a session with the staff of the Northern Plains Resource Council. Attorney Mike Reisner shared the organization's perspective on the CBM issue, citing the problems ranchers have had in Wyoming with drilling companies who have tended to disregard the surface owner's rights to continue with their traditional livelihoods. Of significant concern to the conservation group is the long-term effect CBM development could have on both shallow and deep aquifers and overall groundwater quality. The NPRC has hired its own scientific expertise to engage in the EIS process and to continue its legal challenges, if need be, to influence CBM development in eastern Montana.

A late afternoon visit was paid to Nance Petroleum, one of 80+ companies involved in CBM development in the Powder River Basin. Reservoir Engineer Brian Cebull and Geologist Michael Bryant provided their perspective on the Montana CBM situation and their leases on a ranch in the Hanging Woman basin. Their interest in having an environmentally sound operation, once the moratorium on drilling is lifted, includes the following goals:

- Ensure that a suitable water management plan is in effect to maximize beneficial uses on the surface and ensure the quality of reinjected water with appropriate treatment technologies.
- Enhance the ranch operations for the 20-25 years of CBM production by making the produced water a profit center (e.g. alternative crops, additional livestock watering stations).

- Explore multiple seam completion so to reduce the concentration of development infrastructure necessary on the surface.

Wednesday, May 23: This day focused on building a constructive relationship with Crow Tribal leaders who have previously expressed interest in developing their CBM reserves. Approximately \$300K in FY 2001 DOE funding was available from the Native American Initiative at the National Petroleum Technology Office (NPTO) to help either the Crow or Northern Cheyenne Tribe evaluate the economic potential of their methane resources. This assumes that the CBM can be developed in an environmentally acceptable manner-- requiring re-injection of the produced water – and collaboration among the selected tribe, the Montana Bureau of Mines and Geology and the INEEL. Following a morning meeting with the Rick Stefanic of the Bureau of Indian Affairs, our afternoon visit with Crow Tribal leaders led to an endorsement of this project by Tribal Chairman Clifford Birdinground. *(Note: Because the Crow Tribe later decided against moving forward with this project, the opportunity for this study was offered and accepted by the Northern Cheyenne, whose reservation actually has greater reservoir potential. See Project 6.3.1)*

The INEEL contingent moved on to Sheridan, Wyoming, to visit with Bruce Williams of Fidelity (formerly Redstone Gas Partners) to gain another industry perspective on the need for additional R&D in the coal bed methane arena. This company has been one of the major players in CBM development in Wyoming and has explored a number of water management alternatives with high SAR water. Their preference is to discharge water of good quality on the surface to benefit landowners or to find a suitable buyer for the produced water (e.g. dust control at nearby mines). In cases of low water quality, there are essentially four mitigation alternatives they are exploring currently:

- Injecting produced water into shallow coal seams that lack methane gas, and providing a pressure seal to ensure that water does not reach more potable aquifers.
- Injecting produced water into deeper seams (800' down) well below current methane production, yet still technically accessible for beneficial use at a later date.
- Ion exchange, reverse osmosis or membrane treatment (still requires disposal of a concentrate) as relatively expensive treatment alternatives.
- Deep injection of water beyond recovery, necessitating the drilling of replacement water and/or monitoring wells in cases where tapped aquifer is depleted.

In the late afternoon we enjoyed a tour of CBM drilling operations north of Sheridan in the Lower Prairie Dog Creek area courtesy Jill Morrison and A. D. Ackels of the Powder River Basin Resource Council (see Figure 1). The day ended by having dinner with affected ranchers who desire more scientific documentation of surface and subsurface impacts from CBM activity. Most ranchers at the meeting are not owners of the mineral rights beneath their property, and they have suffered from a variety of impacts as CBM development has extended to the western



Figure 1. Drilling pad and associated infrastructure for coal bed methane development, Lower Prairie Dog Creek drainage, Powder River Basin near Sheridan, Wyoming.

side of the Basin, where water quality is comparably poor. Among the impacts that have been witnessed:

- Increased road building and dust from increased traffic have affected livestock mortality, noxious weed infestations and overall air quality.
- Noise from air compressors operating 24 hours per day has affected quality of life for rural inhabitants.
- Electrical demand for wells and infrastructure has led to more coal-fired power plants on the drawing boards for the region.
- Constant discharge of high SAR or highly saline water has changed the seasonal nature and character of ephemeral streams. Cottonwood trees and associated riparian vegetation have died, wildlife behavior has been affected and on-farm transportation routes have been altered by necessity.

In summary, the local residents would like to see INEEL involved in more site-specific hydrologic and geologic characterization prior to drilling, focusing on how to best manage, treat and if appropriate, reinject the produced water from CBM development.

Thursday, May 24: Our morning in Gillette featured a productive session with Dennis Stenger from the Bureau of Land Management (Buffalo Field Office), Jim Eisenhauer from Wyoming DEQ and the Richard Cool from the Wyoming Oil and Gas Conservation Commission, which permits private and state CBM drilling operations. They all shared the Wyoming experience with CBM production to date, emphasizing that early in the CBM play near Gillette, water was potable and surface impacts were relatively benign. There is a continuing concern among the agencies with how to manage groundwater effluent that has an increasingly high SAR, making irrigation usage or surface discharge increasingly unacceptable given vulnerable soil types.

The DEQ acknowledged being overwhelmed and under staffed in their monitoring and oversight responsibilities of CBM development. They provided a list of primary research needs that included a better understanding of drilling impacts on shallow aquifers and of the fate and transport of CBM effluent water with high SAR. Historic baseline data for private wells are rare, with only recent data coming from monitoring wells. One good sign is the presence of larger companies entering the CBM picture that will have the resources to spend on new treatment technologies and more cost-effective approaches.

The group noted that while coordination among agencies has been poor to date in Wyoming, there are signs of increasing cooperation among affected counties and various resource agencies. Industry is cooperating to fund more necessary studies on water treatment and soil tolerances, and they have formed a Coal Bed Methane Operators Group. The Wyoming BLM will soon be issuing its draft EIS for more leasing on public lands, and Dennis predicted the leasing on BLM ground would move even further west in the state.

Later that afternoon, following a four-hour drive (see Figure 2), we arrived in Laramie for the University of Wyoming open house sponsored by the Department of Renewable Resources. Bob Breckenridge, INEEL Department Manager for Ecological and Cultural Resources, joined the team for the last days of the Wyoming trip. Tom Thurow, Department Chair and former INEEL employee, led an interactive discussion on coal bed methane concerns for the first hour, and nine faculty members then engaged the INEEL team in individual discussions on a variety of subjects including:

- Interest in studying established weed patches on the INEEL to examine the succession of native plants in undisturbed settings.
- Possible INEEL involvement in programs offered at the University's field station/research institute in Grand Teton National Park.
- Reclamation of abandoned mine sites in Wyoming, with \$28 million provided by the Office of Surface Mining.
- Desire to make better use of the Environmental Simulation Laboratory that exists on campus and is being underutilized.



Figure 2. INEEL scientists logged over 1360 miles on the Eastern Montana-Wyoming leg of the journey.

- Aquatic Toxicology Laboratory - 100 gallons per minute of ultra pure water for testing purposes. A \$2.8 million EPRI study is now examining the acidification of fisheries based on changing temperatures and biological loads in aquatic habitats.

Friday, May 25: The trip concluded with a two-hour meeting with Vice-President for Research William Gern and Engineering Dean Gus Plum. Vice-President Gern expressed strongly the University's desire to engage in more collaborative research with INEEL despite their being intentionally excluded from INRA for what he identified as political reasons. Dr. Gern shared his intention to fly over a team of University faculty later this summer to help strengthen their ties with INEEL, which he views as “Wyoming's National Lab,” and to explore how INEEL might better utilize university facilities and institutes for future collaborations.

3.2 Western Montana/North Idaho/Eastern Washington (M. Wright, P. Wichlacz, J. McCarthy, T. Rutz, J. Brown)

Monday, June 11: The first stop on this trip was Butte for a view of the Berkeley Pit Superfund Site (see Figure 3) and a visit with folks at Montana Tech. We were impressed with Montana



Figure 3. Scientists from the Montana Bureau of Mines and Geology (top photo) orient INEEL staff to the Berkeley Pit Superfund Site (bottom photo) in Butte, Montana.

Tech's warm hospitality as we were welcomed with a catered lunch on campus and serious discussions about research needs in the region. Dr. Frank Gilmore, Chancellor and University Executive Vice-President, provided an important perspective on the role of Montana Tech as an affiliate of the University of Montana. Seven scientists employed by the Montana Bureau of Mines and Geology, which is part of Montana Tech and headquartered on campus, also provided their thoughts. Edmond Deal, the Bureau Director and State Geologist, was most encouraging about their desire for collaboration with INEEL, and Wayne Van Voast, Research Division Chief, inspired us with his ideas for "big picture" research. One such idea was accelerating the rate of acid mine drainage so to better control and treat the contaminants in a defined time frame (e.g. 25 years instead of 250 years).

Heading north to Helena, we were pleased to meet with the Montana DEQ Director Jan Sensibaugh, who spent two hours with us as we covered topics of concern, such as improving the agency's ability to predict water quality effects from new hard rock mines. Administrator Art Compton also joined us to explain Montana's position with respect to coal bed methane (CBM) development and their upcoming release of the statewide EIS in conjunction with the BLM. Jan and Art expect that development of CBM will be going forward in Montana (depending on the outcome of lawsuits, etc.), but the conditions under which that development goes forward is still a matter of discussion. Research into re-injection of produced water would have their support, so we need to keep them in the loop on INEEL's work with the Northern Cheyenne Tribe.

Our day concluded with a visit to the Montana Natural Resources Information System, which also encompasses the state's Natural Heritage Program (rare species inventory program established by The Nature Conservancy, which is housed in Fish & Game agencies in most states). This data clearinghouse and management service is part of the Montana State Library, which provides an apolitical atmosphere and nonpartisan information service to legislators, agencies and the public. An impressive Web-based service was demonstrated by NRIS Director Jim Hill and Allan Cox, Systems and Services Manager, and they communicated a real desire to work with the Lab in areas of mutual interest.

Tuesday, June 12: A breakfast meeting was held with Todd Everts, Director of the Montana Environmental Quality Council, who operates this legislative services arm of the Montana Legislature between their biennial sessions. Coal bed methane remained the agenda topic as we met with Rick Moy, Chief of the Water Management Bureau of the Montana Department of Natural Resources and Conservation and his staff. We discussed the implications of their "designated groundwater area" for the Powder River Basin, and listened to other research thoughts on protecting groundwater resources advanced by staff hydrologists in attendance.

A brief meeting with the State Director of EPA, John Wardell and Bob Fox, Superfund Branch Chief, gave us an important federal perspective on the Clark Fork Superfund Project. The decision is imminent on the Milltown Dam to either remove or immobilize contaminated sediments behind the dam and address the associated arsenic plume just upstream of Missoula. We gained additional perspective on this issue and the plethora of problems associated with abandoned mine sites from the Remediation Division of DEQ. Included were Sandi Olsen, Division Administrator, Vic Andersen, Chief of the Mine Waste Cleanup Bureau, Hydrogeologist Bill Uthman, and Keith Large, Project Officer on Milltown Dam.

A windy tour of the Milltown Dam was provided by Montana Power consultant Jim Stilwell (see Figure 4). Keith Large from DEQ accompanied us all the way from Helena, and Peter Nielson of the Missoula City-County Health Department weighed in with their support of removing the dam as well as the sediments. We dined with staff of the citizen-based Clark Fork Coalition, including Executive Director Tracy Stone-Manning, who shared their organizational perspective on dam/sediment removal and cited what they believe to be an inadequate scientific understanding of the entire Clark Fork drainage with respect to how Superfund decisions are being made.



Figure 4. Montana Power consultant Jim Stilwell describes the issues associated with the Milltown Dam, on the Clark's Fork near Missoula, Montana.

Wednesday, June 13: Daniel Kemmis, Director of the O'Connor Center for the Rocky Mountain West, hosted us for a friendly open house for University of Montana faculty and administrators. Present were Dr. Lloyd Chestnut, Vice-President for Research and Development, and eight other faculty and administrators. We visited the Northern Rockies Center for Applied Computational Science, funded by NSF/EPSCoR, which included a "Virtual Venue" for classes and conferencing with multiple sites across the country. Several faculty members joined us for lunch to discuss future collaborations through INRA and their varied research needs in the region.

On we drove to Coeur d'Alene, where Sarah Bigger, Field Director for Senator Mike Crapo, gathered five agency and industry interests involved in the cleanup of Bunker Hill and the assessment of over 500 abandoned mine sites to discuss their science & technology needs. Included were representatives from the U.S. Forest Service, Bureau of Land Management, Idaho DEQ, Earthworks Technology Inc, and Hecla Mining. Kathy Johnson, Project Director for DEQ, expressed the need for new technology to prevent the leaching of zinc as the current tailings pile treatment is capturing all the cadmium and lead that used to leach out, but zinc is not being retained.

Thursday, June 14: The day began with a visit to the University of Idaho and an open house in its new Idaho Commons building. Roy Mink of the Idaho Water Resources *Research Institute* hosted the event, which drew ten faculty members, including Earl Bennett, Dean of the College of Mines, and Ron Crawford, Director of the Environmental Biotechnology Institute. Dr. Charles Hatch, Vice President for Research and Graduate Studies, joined Earl and INEEL visitors for lunch, where we discussed further several UI research interests and concerns.

The afternoon open house at Washington State University in Pullman was co-hosted by Dr. Claudio Stockle of the Washington Water Research Center and Ed Weber of the Foley Center for Public Policy and Public Service. Seventeen faculty and administrators attended the two-hour event, which included Dr. Ken Spitzer, Associate Vice Provost for Research and Dr. Eugene Rosa, Chair of the Department of Sociology.

Friday, June 15: Before embarking for the 518-mile drive home, we stopped at the Nez Perce Reservation in Lapwai to visit with several staff in the Tribe's Department of Natural Resources, including the Environmental Restoration and Waste Management Division and the Water Resources Division. Environmental Specialist Judit German-Heins made a presentation at the EPA Vadose Zone Roadmap workshop earlier in the month, where she invited INEEL to visit at the end of our journey to learn more about the Nez Perce research interests and environmental concerns, both at Hanford and INEEL. The productive two-hour meeting reinforced how connected we all are in the Columbia River Basin and the Tribe's desire for more involvement and educational outreach.

In Summary: Based on our varied discussions, the region's needs for scientific research and technology development should include these topics:

- Fundamental microbial ecology of various major ore bodies
- Real time measurements for metals of concern
- Methods of removing zinc contamination that are cheap and passive
- In situ abatement of contaminants
- Groundwater hydrology characterization at Butte/Anaconda
- Predictive tools to examine alternative bio-hydro-metallurgical scenarios

- Stabilization methods for abandoned tailings ponds
- Hydraulic isolation using vitrification of tailings
- Advanced monitoring techniques that can operate remotely for hard-to-reach sites.

3.3 Alaska (R. Jacobsen, R. Jones, C. Thomas, G. White, P. Wichlacz, and J. Brown)

Monday, July 16: The Journey began on the University of Alaska Fairbanks campus, where we were welcomed by Dr. David Woodall, Dean of the College of Science, Engineering and Mathematics (CSEM is a large college with 150 faculty). The Geophysical Institute and the Arctic Region Supercomputing Center were among the institutes represented in the morning session. It was noted that the Department of Energy plans on establishing an “Arctic Energy Technology Center” in Fairbanks with two full-time DOE personnel assigned to administer a \$10 million annual budget.

A visit to the popular natural history museum was followed by lunch at the historic Pumphouse Restaurant on the Chena River and an open house attended by eight interested friends and faculty. Discussion topics included: energy needs for remote locations, nanotechnology, Fort Wainwright clean up challenges, coal bed methane development and the lack of subsurface data throughout the state. A visit to the Hydrogen Lab at the UAF Energy Center completed our day on campus, which features an impressive array of new buildings and research facilities (see Figure 5).



Figure 5. Dr. Dennis Witmer describes the experiments being conducted at the Hydrogen Lab at the UA Fairbanks Energy Center.

Tuesday, July 17: Flying on to Anchorage, the group spent the morning at the University of Alaska Anchorage campus, guests of Dr. Orson Smith and the School of Engineering (see Figure 6). Following a brief meeting with Chancellor Lee Gorsuch, we met with ten faculty and associates representing the Environment and Natural Resources Institute and the departments of Civil Engineering, Geomatics and Computer Systems Engineering. The INEEL was invited to participate in planning the School's annual January conference, for which a topic has yet to be chosen. A catered lunch was provided for all participants.



Figure 6. Dr. Orson Smith provides Dr. Richard Jacobsen, INEEL Chief Scientist, a tour of the UA Anchorage Engineering facilities.

It should be noted that the University of Alaska is self-described as a “multi-campus system” with three units at Fairbanks, Anchorage and Juneau. All community colleges operate under the jurisdiction of one of these three campuses. The University President is Mark Hamilton, who is located in Fairbanks but supervises the entire system, including the three university chancellors. A visit to www.alaska.edu explains the nature of Alaska’s higher education system and demonstrates how the three campuses are linked. For example, Alaska just received a 3-year, \$10.5 million EPSCoR grant from NSF that will fund research both at Fairbanks, the “traditional” research campus, and at Anchorage. To quote Hamilton, “We are expanding the

programs in both Anchorage and Fairbanks, working together to begin to provide the engineers needed in the state.”

While there are still tense times between Fairbanks and Anchorage at the administrative level, collaboration reportedly is increasing among faculty and PIs. Joint graduate programs, such as the Engineering and Science Management Graduate Program, confer intercampus Ph.D. degrees. For this reason, it will be important for the Inland Northwest Research Alliance to consider the entire University of Alaska system for membership rather than limit membership to only the Fairbanks campus. Although Fairbanks clearly has a larger faculty and finer facilities, the engineering undergraduate program at Anchorage actually has more students and, to quote Orson Smith, UAA is being “buffeted by the winds of opportunity.”

In the afternoon the group focused on the circumpolar north with a meeting set up by Mead Treadwell, Managing Director of the Institute of the North. Because we met at the Hickel Investment Company boardroom, we were treated with a visit and words of wisdom from former Governor Walter Hickel. Also joining us were Nick Goodman of Entegriety, an alternative energy company, and Carl Hild of the UAA Institute for Circumpolar Health Studies. Much of the initial discussion focused on the need for appropriately designed and scaled transportation, energy and infrastructure for arctic communities. Also of concern is the environmental health of the region given studies that demonstrate increased concentration of toxins and radioactivity in arctic subsistence foods such as caribou and salmon.

Wednesday, July 18: Our discussions of the circumpolar north continued with John Doyle, E.D. of the Northern Forum, an international organization with 24 members representing 28 subnational or regional governments from ten northern countries. Their common characteristics belie their common problems:

- Harsh climates and vulnerable ecosystems
- Small populations with strong and diverse indigenous cultures
- Economies based primarily on extraction of natural resources and outsourcing of all goods
- Limited internal investment capital and high operating costs
- Limited infrastructure, mostly oriented in North-South directions
- Limited influence on national government and multinational corporate decision making.

John encouraged INEEL to become involved with their organization and to attend their 10th anniversary and general assembly in Edmonton, Alberta, September 19-21.

At the Alaska Oil and Gas Association, Assistant Director Marilyn Crockett hosted the five major oil companies for a 1-1/2 hour roundtable discussion. Included were environmental representatives from Phillips Alaska, BP, ExxonMobil, Anadarko and Unocal. Among the topics discussed were:

- The need for bioremediation of diesel-contaminated gravel at former drill sites
- Better hydrologic understanding of deep-well injection sites for solid wastes
- Improved methods for moving across tundra (i.e. a hovercraft or other air-cushioned vehicle)
- A new extension drilling method to reach out under continental shelf
- Improved methods for burying pipelines in permafrost regions
- Better leak detection sensors, especially to detect corrosion where visual inspections cannot be made currently
- A variety of subsurface engineering needs to address unique drilling situations
- The need for an ongoing roundtable on caribou (INEEL has been invited to participate in November's Caribou Summit up in Fairbanks)
- Request for an INEEL scientist (Dr. Greg White) on BP's research review team.

We changed gears in our visit with Commonwealth North, a nonprofit group with 430 individual members focusing on emerging policy issues in Alaska. Executive Director Duane Heyman underscored the need for more baseline environmental studies in Alaska with planned stakeholder involvement and objective discussions. He conveyed what we heard throughout our visits: that Alaska is overly dependent on oil and gas development, and that a more diverse economy is needed to ensure the future health of Alaska.

We enjoyed a nice lunch at the Petroleum Club with Tadd Owens and Bob Stiles, the leadership team of Alaska's Resource Development Council. The Council represents the views of the many resource industries in Alaska, and also has labor unions and tourist industries as part of their constituency. Interestingly they shared many of the same concerns advanced by Commonwealth North and they agreed with others that "Hi-Tech" Alaska is not a realistic goal at present. They concurred that research affiliations with the University of Alaska should be systemwide and that there are numerous opportunities for collaboration with industry as well.

The U.S. Minerals Management Service provided a warm welcome with four staff in attendance including Regional Director John Goll. One person commented on his pleasure in meeting Charles Thomas in person, complimenting his publications as helpful in their work. Among their ideas and concerns were:

- The need to improve pipeline technology, specifically in monitoring corrosion and the ability to monitor both single and double wall pipe for leaks.
- Gas optimization is difficult without having industry estimates on their discoveries. Could INEEL serve as an objective intermediary?

- Can INEEL characterize blowout events in order to accurately assess the risk inherent with oil and gas development? This would involve rock mechanics and related disciplines.
- The agency needs more core capability in field sciences.

Our evening was spent with two people interested in the health of rural villages, which are largely native peoples in Alaska (see Figure 7). Epidemiologist Michael Bradley of the Alaska Native Health Board (representing 22 native health associations) shared the multi-agency goals for a U.S. Arctic Contaminants Program that addresses the concentration of contaminants in the Alaskan Arctic. The sources are many:

- Over 2000 known contaminated sites on land, 700 of which are military and five are designated Superfund Sites.
- Industrial wastes from Russian rivers -- circulatory patterns show how these wastes move into the Alaskan waters.
- Airborne radionuclides are going down with the reduction in atmospheric testing. DDT is going down, but mercury concentrations are going up, especially in farmed salmon.



Figure 7. Anchorage serves as a major shipping port to access Alaska's remote rural communities.

Michael recommends a comprehensive environmental surveillance effort that is coordinated with traditional food safety programs, provides data to those affected in ways easily interpreted, involves the communities in their own monitoring and learning, and demonstrates a level of sensitivity to the people and their home. Among the ideas discussed was INEEL designing a floating, mobile laboratory that could serve coastal and river communities on an ongoing basis. The lab would have to handle a range of tests that eliminated the need for sending samples to remote laboratories and enabled people to get involved with monitoring their own subsistence foods and their own health.

Also in attendance was Rachel Morse, District Coordinator for the Alaska Soil and Water Conservation District. She is working with an Intertribal Watershed Coalition of five tribes that is seeking training and funding assistance to establish baseline conditions along the Kobuk River before new road and subsequent mine construction occurs.

Thursday, July 19: We had breakfast with Paul Glavinovich, Minerals Consultant with the NANA Native Corporation, who operates the Red Dog Mine (largest zinc and lead mine in AK). The mine employs a high percentage of native shareholders, but not in highly technical positions where NANA wishes more qualified natives were available. Paul outlined the mine's water quality protection measures and expressed his frustration that baseline conditions were not documented prior to the mine's operation. With respect to INEEL capabilities, Paul showed interest in how one would go about predicting what conditions might have existed prior to mine development in order to resolve their current road dust problem with the State DEC. A state study attempted to do this using moss, but he doubts the scientific veracity and interpretation of the study.

Seven employees of the Alaska Department of Conservation attended or teleconferenced in to our morning session, including representatives of the Division of Air & Water Quality, the Division of Spill Prevention and Response, and the Division of Environmental Health. Among the topics discussed were:

- Long-Term Stewardship at Amchitka Island (keep them in the loop)
- Alaska's involvement with the Consortium for Risk Evaluation with Stakeholder Participation (CRESP-2 with DOE-Nevada)
- Encapsulation technologies for dealing with acid mine drainage
- Gas to liquid technologies and alternative fuels
- Coal bed methane development
- Remote site energy solutions that take local climate into account
- Bioremediation of petroleum products – both surface and subsurface
- Dealing with dry cleaning solvents, finding DNAPLs, risk management alternatives for removing UXOs/explosives

- Cleanup of nonmilitary contaminated sites (85-90% hydrocarbons). Can biotech help?
- Toxicological risk studies have not been applicable to soil/groundwater cleanup challenges in Alaska.
- Sampling of foods and environment to become a higher priority. (Would Ion Mobile Spectrometer help?)
- Challenges with rural sanitation, particularly nitrates
- Need for instant (black box) testing of PSPs; remote sensing of dinoflagellate plumes

Suzanne Marcy, Arctic Program Manager and Senior Scientist with the *USEPA*, discussed the need for a cumulative impact study of energy development on the North Slope. Her preference would be an Ecosystem Risk Assessment that documents an array of possible impacts and not just from energy development. If the Arctic National Wildlife Refuge was used as a control, a structured comparison might be made of what was lost and what remains as Prudhoe and other North Slope fields have been developed.

The Bureau of Land Management sent representatives from their Lands, Mineral and Resources Division to discuss a wide range of topics. We were reminded that the BLM has retained the subsurface mineral rights for lands not conveyed to the State or Native Corporations. They administer 24 million acres in Alaska, the largest tract of BLM land in the nation, including the National Petroleum Reserve-Alaska withdrawal, which is now being leased for new exploration on the North Slope. Discussion included these topics:

- Surface-related monitoring needs from migratory birds to natural oil seeps to changes in hydrology from the melting of ice roads.
- Abandoned sites: placer mines, solid waste dumps, legacy well heads. How does one document if a well has closed naturally – to plug or not to plug?
- Coal bed methane- gas hydrates. BLM has signed an MOU with the state to look at alternative energy sources for the native villages as 98% use diesel generators for electricity.
- Telemetry and new remote sensing techniques for locating mineral deposits.

Two divisions of the Alaska Department of Natural Resources were present for our afternoon meeting: Division of Oil and Gas and Division of Mining, Land & Water. The primary topic of discussion was coal bed methane gas development, which was mandated for leasing back in 1996 with DNR opposing the legislative action. Some 307 lease applications have been issued at \$500 per application on a noncompetitive basis. Reinjection of the production water appears to be preferred, but the DNR is ill equipped to perform the necessary hydrologic analyses (no maps) and design mitigation strategies.

In line with this discussion was the fact that little or no baseline data exist, yet DNR is expected to set up monitoring of large surface mining operations on state land. The military also transferred some of their former sites to the State, so contaminant and cleanup programs are now part of the DNR's responsibility.

Our last meeting of the day was with Colonel Steven Perrenot of the US Army Corps of Engineers, Alaska District, and several of his planning and operations staff. The Corps has been active on the Denali Commission, a multi-federal agency task force that is coordinating assistance to rural Alaskans. The Corps has assumed the responsibility to seek out proven energy technologies for remote communities and conduct public involvement activities associated with their activities. They also administer the Formerly Utilized Defense Sites program, which entails site assessment and cleanup responsibilities. Colonel Perrenot indicated interest in biotechnologies or any process that might be less expensive than digging and transporting contaminated dirt.

A field trip north of Anchorage to the abandoned Goose Bay Nike Site was the evening highlight, which introduced us to local Alaskans concerned with their community welfare (see Figure 8). This defense site operated from 1950-80 and was given to the State for use (in part) as a corrections facility. Now largely under the ownership of the University of Alaska Fairbanks, the site is a public safety hazard and possible source of hazardous materials. The local citizenry is demanding a more comprehensive assessment and interpretation of remaining health hazards and tightened controls on public access. The site would be an ideal case study for the Long-term Stewardship program, with an onsite workshop for hazard assessment, remediation planning and stakeholder involvement.

Friday, July 20: The journey to Alaska finished on a relaxed note with a visit and lunch with the Alaska Science and Technology Foundation. Ex-INEL employee Bob Chaney hosted the meeting along with ED. Jamie Kenworthy. An array of topics discussed included:

- Ray Latchem is manufacturing and transporting LNG up to Fairbanks from Anchorage and wants to establish LNG stations at Denali National Park and other logical points along the way. He needs a place to demonstrate a re-gasifier that really works.
- A new de-sulphurization technology is needed for arctic grade diesel for the small percentage of fuel requiring it. Rather than importing this treated diesel through Edmonton, a pilot project demonstrating an efficient chemical process is desired.

While INEEL remains on positive terms with ASTF, it is our responsibility to bring suitable proposals to their attention rather than wait for them to seek us out.

The final visit was to the U.S. Fish and Wildlife Service, with Research Coordinator Tony DeGange hosting us. It was noted that Steve Williams, the former head of Kansas Fish, Wildlife and Parks, has been tagged to head the agency under the new administration. Tony scrolled through a number of interagency projects with which USFWS is affiliated, including SEARCH – The Study of Environmental Arctic Change. We learned that DOE will also be involved with this long-term monitoring program from the perspective of understanding global climate change. Tony noted that Prudhoe Bay lacked good baseline information at the beginning of its



Figure 8. Local residents tour INEEL scientists through the abandoned Goose Bay Nike missile site near Wasilla, Alaska. The state-owned site is a good example of the failure of institutional controls to isolate the public from potential safety hazards.

development, so the USFWS stands to receive good funding for baseline assessments of ANWR should leasing go forward. An aggressive program to complete land cover maps for all the Alaska refuges is also being conducted.

3.4 Utah and Southern Idaho (B. Apel, B. Breckenridge, J. Brown, M. Hamilton, J. McCarthy, T. Rutz, M. Wright)

The final leg of the Journey for Regional Relevance was in familiar territory for most of the INEEL travelers. While awareness of the INEEL was greater in Salt Lake, Twin Falls and Boise than in more distant locations in the region, most people were not aware of the Lab's extensive research and development capabilities with the exception of some faculty at the four universities we visited.

Monday, August 13: Utah State University in Logan was the first stop on this trip, with Ron Sims, Director of the Utah Water Research Laboratory, hosting a diverse group of 12 faculty and

administrators. Ron explained Governor Leavitt's new initiative aimed at tripling the number of engineering students and doubling the number of those entering computer sciences over the next eight years to meet increasing demand in Utah. In support of this goal, a \$36 million engineering building is under construction on campus.

A round-robin overview of faculty interests and expertise followed the INEEL overview of the Subsurface Science and Environmental Stewardship initiatives. Among the topics discussed were:

- Statistical and probability models and visualization tools in support of integrated modeling for watersheds. USU is looking at new ways to link surface and groundwater models, as well as integrate stakeholder information (current collaboration with INEEL).
- Watershed science within the College of Natural Resources, particularly in measuring biotic conditions in streams. Stewardship science is also a CNR activity as they are working with DOD on reanalyzing 1972 Landsat images to document change over time and to build GIS metadata sets.
- Sedimentation models that take erosion/landslides/geomorphology into account with modeling structured flow paths. This includes numeric and physical models of mountain erosion.
- Understanding how microorganisms interact with the environment, particularly in successional processes, rates, and predicting acclimation methods.
- USU's continuing work in phytoremediation where natural attenuation of metals at abandoned mine sites is being researched using plants to stabilize and possibly extract metals such as lead, cadmium and arsenic. Stabilization currently appears more feasible than extraction.
- Certification courses for installers of on-site wastewater systems (septic tanks) are being offered by USU (Judy Sims) using a demonstration site constructed on campus for this purpose. There also is special interest in density modeling to help rural regulators limit nitrate effluent from these systems in concentrated subdivisions.
- Cleaning up TCE at Hill Air Force Base is challenging without better tools to identify carbon donors and a better understanding of the heterogeneity of the site. Discussion ensued as to why SSI feels that mesoscale experiments would be superior to going straight to field scale, and why too few advances have been made in the field of hydrogeology over the past two decades. Enhancing contrasts in the subsurface will be needed in order to detect contaminants that currently are not detectable.
- Regarding INEEL relationships in general: a central point of contact is needed to better identify potential principal investigators, get more involved in USU seminar offerings, etc.

Another 1-1/2 hours on the road from Logan to Salt Lake City (see Figure 9) permitted an afternoon appointment with Dianne Nielson, Executive Director of the Utah Department of



Figure 9. Another 1,000 miles were logged on the Utah-Southern Idaho trip during a hot week in mid-August.

Environmental Quality, and her deputy Brent Bradford. Dr. Nielson had numerous questions of the INEEL team with respect to the new Subsurface Science Initiative as well as how DOE establishes priorities and budgets for R&D. A number of environmental challenges were discussed, such as leaking underground storage tanks and the controversy with MagCorp on the Great Salt Lake (chlorine emissions and dioxins needing attention). Dianne emphasized that most DEQ issues, such as MagCorp, are regulatory or jurisdictional in nature, and do not require scientific breakthroughs or new technology development. She suggested that, in most cases, the marketplace is finding necessary scientific solutions when questions arise.

Two issues were noted, however, where market incentives do not exist or have been removed, and she believes that government R&D is yet needed:

- Keep working on a permanent solution for high level radioactive waste disposal.
- The cleanup of RDX and nitrate plumes at the Trojan Plant at Mapleton, Utah, involves excess treatment water that must be discharged, preferably for beneficial use. In order to use the water to irrigate vegetables and fruit trees, basic research is needed into the uptake of RDX by various crops to ensure that bioaccumulation of the toxin does not occur.

In the late afternoon a Conservation Roundtable, hosted by Jeff Salt of Great Salt Lake Audubon, attracted a dozen individuals from eleven different agencies and organizations. Among the issues raised by these participants were:

- The need to explore improved treatment technologies for drinking water systems that have naturally higher metals and arsenic.
- Concern with the proposed Jordan River Recharge Project that will be recharging water of questionable quality into shallow aquifers from some 247 wells. Some people questioned if agencies have sufficient knowledge about the system to ensure it is not radically disrupted during this process.
- Stormwater system designs for the Wasatch Front should be improved to encourage more percolation and minimize runoff impacts to Great Salt Lake and environs.
- Great Salt Lake may be in peril as the ecological structure of the lake is not well understood. Are nutrient cycling processes even working? As we add salts and partially treated sewage daily to the system, are we disrupting the natural balance?
- Conjunctive management of ground and surface waters require more advanced decision analysis tools to improve performance and link the ecological component.
- Don't forget the impacts from dispersed recreation as the local population explodes.
- A regional focus on science and technology will improve technical objectivity, an area where many believe government agencies need improvement.
- Local government officials are interested in training opportunities, particularly in the planning & zoning offices where decisions are made on density, riparian buffers, etc.
- INEEL should provide something like a "Consumer Report" on available technologies so local officials can receive guidance in this area.
- Can a local citizen monitoring effort avail themselves of the Lab's expertise and links to other monitoring efforts in the region?

(One participant contacted the Lab following the meeting with concerns about Envirocare's hazardous waste site in Utah. Apparently the leak detection system has failed in several Envirocare operations in other states, and this person felt that some assistance might be needed in Utah to assess whether the system is working adequately at their site.)

Tuesday, August 14: The morning was spent at the Energy and Geoscience Institute on the University of Utah campus where Director Ray Levey brought together eleven EGI staff and university faculty representing the departments of Geology and Geophysics, Civil and Environmental Engineering, and Computing. Mike Wright, former EGI director, described the new SSI that brought him to Idaho Falls and described the anticipated calls associated with vadose zone research.

The University of Utah is not an INRA institution, but serious interest still exists in becoming a member. They believe inclusion of the "U" would be politically astute as access to the entire

Utah Congressional delegation could be assured, and Governor Leavitt has a close relationship with President Bush that could be helpful.

Past frustrations with INEEL collaborations were noted, however, that included cases where proposals were jointly written and not funded, yet resubmitted the following year without the very EGI personnel whose ideas still appeared in the new proposal. While they felt this bordered on theft of intellectual property rights, much less lack of ethics, the EGI is hopeful that future collaborations with INEEL will have greater institutional integrity. Towards that end, Lynne Chronister in the Office of Sponsored Projects seeks to establish a Master Task Order with INEEL so that individual contracts with EGI could be placed under an umbrella agreement, if possible. Name to know: Ray Gestland, new VP for Research Topics discussed over the two-hour session included:

- Implications of HB 2460, “Natural Gas and Petroleum Research Development and Demonstration Act of 2001” for EGI and INEEL who have geothermal research capabilities (particularly since the bill provides for ten percent of the fund to be focused on long-term energy supply R&D and global climate change mitigation R&D.). EGI currently receives a \$1.5 M pass through from our geothermal office. One new research suggestion was examining seafloor geothermal potential.
- Connecting one researcher engaged in contaminant fate & transport research with Envirocare to investigate use of the Environmental Simulation Laboratory at the University of Wyoming.
- Phillips Inc. has bought into coal bed methane activity in Utah, expecting to develop 300-500 wells over the next 12 months. The USGS approached EGI to assist with researching the issues associated with more aggressive CBM development.
- Computational skills that EGI offers were discussed, including CSAFE (addressing accidental fires and explosions) and SKIRUN (graphics program with advanced visualization and animation capabilities).
- Can we encourage more interchange of scientists between the two institutions, such as cost-sharing speaker’s programs, providing visas of potential PIs, exploring sabbatical opportunities, and targeting specific research programs for collaboration?
- The EGI crew encouraged INEEL to retain our applied engineering expertise as we should not lose our experience in practical applications of technology.

Lunch was enjoyed with Rick Reese, local author (Utah Geographic Series) and part-time Director of Community Relations with the University of Utah. His familiarity with Utah environmental issues prompted the invitation and yielded a particularly interesting idea for studying the Great Salt Lake:

- What about forming a three-way collaboration to study the sediments in the Great Salt Lake to assess global climate change? Atmospheric temperatures would permanently recorded in geologic structures based on the pollen embedded in the layers. Contacts should include

Dave Chapman at USGS and Dennis Nielson in Civil Engineering at the University who have experience in coring lake bottoms. A related benefit would be assessing the changes related to increased human habitation along the Wasatch Front (i.e. tracking the changes associated with increase of autos and petroleum refineries).

A brief visit with George Hopkin, Chief of the Environmental Quality Section of the Utah Department of Agriculture and Foods, underscored the power still wielded by farming interests in the state, which remains the number one industry in Utah in terms of revenue. His interests included having improved runoff models for lands applying herbicides and teaching farmers to reduce the quantities of chemicals used. It should be noted that the largest buyers of commercial fertilizers in Utah are actually golf courses and parks, which have been working with his agency to control stormwater runoff. With respect to the 20 CAFOs (confined animal feeding operations) permitted in Utah, George emphasized their voluntary approach to compliance that encourages best management practices and avoids permitting requirements altogether by reducing animal density.

Our last Tuesday appointment included four officials from the Utah Department of Natural Resources: Deputy Director Hugh Thompson; Lowell Braxton, Director of the Division of Oil, Gas and Mining; Thomas Brill of the Office of Energy and Resource Planning and Richard Allis, Director of the Utah Geological Survey. The discussion yielded important perspectives on the following topics:

- It was agreed that septic tank density is an increasingly important issue to Utah, as it was confirmed that very primitive calculations are being applied currently. The greatest concern comes from tank placement in fractured limestone formations.
- Over 1500 coal bed methane wells have been developed in Utah, but most have produced potable water. Produced water with high TDS is being injected into Navajo Sandstone formations or mica shale that has no freshwater aquifers. Some reverse osmosis treatment technologies are being applied to the more saline waters produced. As more development occurs it will be critical that site specific information is available to make the best decisions on water treatment and discharge/injection.
- Aquifer depletion continues to be a concern in Utah, with Curlew Valley on the Idaho/Utah border cited as an example of out-of-state pumping affecting Utah aquifers. The USGS is involved, and INEEL was encouraged to gain an awareness of this kind of problem, especially between states.
- The DNR has a different, less alarmed perspective on the Jordan River Recharge Project as the agency believes the excess water in the river can be safely recharged as long as water quality is not reduced in the shallow aquifers.
- A discussion of Utah's oil and gas resources revealed that less than 15% of the known oil reserves are actually recoverable using current technology. The natural gas potential is more promising with exploration at 5,000-7,000 foot depths. The DNR was supportive of continued R&D and believes industry will collaborate as more investment is being made in Utah.

- Additional research discussion focused on carbon sequestration, natural surface flux of CO₂ and gas drilling completion technologies. A pilot scale demonstration of the soil uptake of CO₂ is being contemplated in Utah with Pacificorp as a possible partner. Would INEEL be interested?
- The lab was invited to participate in a two-day coal bed methane symposium in March 2002 to help inspire industry to think beyond their immediate development and water management challenges.
- The Utah Geological Survey asked for a current list of potential principal investigators at INEEL as they often are in need of partners for the grants they receive. Allis suggested that a comprehensive list of current projects be placed on our Web site along a list of appropriate personnel.

Wednesday, August 15: Traveling up to Twin Falls on our way to Boise, the team met with 13 local government and economic development officials at the Mid-Snake Resource Conservation and Development office. Julie Thomas, District Coordinator, ensured that representatives were present from Jerome, Twin Falls, and Cassia counties, and the cities of Albion, Jerome and Heyburn. The roundtable discussion yielded the following concerns and opportunities:

- It is important for agencies to streamline and better coordinate their efforts to minimize public confusion. How coordinated are data collection and analysis efforts among the agencies? Are ecological data as integrated and accessible to the public as they should be?
- The Mid-Snake Water Resource Commission is relying on the US Geological Survey for groundwater modeling and analysis of the worsening nitrate situation around Twin Falls, which is considered among the worst in the state.
- The local governments voiced frustration with the national regulatory scene, using the recent change in the arsenic standard as evidence that the limited treatment capabilities of small rural communities are not considered in the rulemaking process.
- Interest was high in receiving technical assistance from the INEEL, particularly from those operating wastewater treatment systems that are in need of upgrades. Of interest was independent evaluation of system designs and treatment technologies being advanced by vendors. At a minimum, local governments would like help with “what questions they should be asking” of the different engineering firms bidding on their projects.
- It was suggested that INEEL scientists meet directly with the dairies and cheese factories responsible for the increasing wastewater load and odor concerns. (The RC&D offered to help convene such a gathering). The group felt the larger dairies are willing to tackle their wastewater and odor problems, to the extent they have organized a new group, Milk Producers of Idaho, and are applying new technologies.
- In order to respond to increasing public outcry about dairy odors, the officials asked whether an “odor meter” exists to determine the intensity and seriousness of an odor to the

point where a public health hazard may exist.

- Cassia County shared their weariness from dealing with the drought situation just after defeating a CAFO proposal earlier in the year. Siting issues with CAFOs and dairies are becoming economic development issues in their towns.
- Finally, INEEL was encouraged to become a qualifying Idaho service provider so to be placed on potential vendor lists for assisting local governments.

The team drove across to Boise in time to attend a 25+-person Open House sponsored by Dr. Jack Pelton at Boise State University (BSU). A cross-section of disciplines was represented from several colleges including Arts and Sciences, Business and Economics, Engineering, Graduate Studies, Social Sciences and Public Affairs. After receiving a briefing on why INEEL is journeying across the region, the group discussed in detail the university's strengths and weaknesses, particularly as more productive collaborations with the Lab are contemplated in the future:

- The increasing expertise of the Center for Geophysical Investigation of the Shallow Subsurface (CGISS) was emphasized, with frustration expressed that the INEEL does not seem to evaluate fairly the emerging capabilities of regional institutions before selecting its partners from elsewhere. Still, several faculty admitted that BSU has to make certain academic strides and add expert faculty in order to compete more favorably on the research front.
- The BSU Environmental Finance Center was profiled, underscoring how local governments in Idaho can be assisted with their financial and planning needs as new technologies are being sought.
- As we have heard at several other institutions, the INEEL was criticized for being relatively inaccessible to outsiders. Frustration was expressed by a few who received the "run around" as they sought out potential collaborators at the Lab.
- The need for a comprehensive list of scientists, their disciplines and publications was reiterated as was a request for more frequent interactions with Lab personnel.
- Acknowledgment was made of the tension that still exists between the University of Idaho and Boise State, much of it related to the move of the Engineering School.
- A field tour of the Boise Hydrogeophysical Research Site along the Boise River was enjoyed in the early evening (see Figure 10). This research wellfield has been developed by CGISS in a shallow, cobble-and-sand, alluvial aquifer. The design of the 18 wells and the wellfield itself provides for a wide range of hydrologic-geophysical tests, some of which the team witnessed during its visit to the site.

Thursday, August 16: The day began at the offices of Senator Mike Crapo, who was represented by Chief of Staff John Hoehne with Legislative Director Peter Fischer and John Anderson on the speaker phone from Washington D.C. Also present were Congressman Mike Simpson's



Figure 10. INEEL's Dr. Mike Wright (top photo) is briefed by Dr. Warren Barrash on the latest field experiments being run at BSU's Hydrogeophysical Research Site along the Boise River.

Resource/INEEL Director Laurel Hall and Ada County Field Director Nichole Watts. District Director Tana Shillingstad represented Congressman Butch Otter.

Following introductions and a brief description of the Subsurface Science Initiative provided by Mike Wright, John Hoehne led the discussion of the need for INEEL to have some real successes with respect to assisting Idaho and the region with their science and technology needs. Two points were highlighted with respect to INEEL performance:

- Many INEEL initiatives that have been generated or supported by the Senator seem to get some interest initially, then fall flat. There appears to be a big problem in getting results. Perhaps we need a ‘go to’ person who would be responsible for taking good ideas and working them through the bureaucracy.
- While we think the concept is very sound, the INEEL program that provides 40 hours of technical assistance for community-related problems seems to have minimal results. Can the program be reconfigured to yield more tangible results?

Discussion then focused on the stalled “Natural Resources Institute” initiative that has been of keen interest to Senator Crapo. The possibility that the Lab would institute a similar, yet less ambitious program for the region under Western Connections was met with positive, yet cautious enthusiasm: “Will this effort be any different? Don’t waste our time if INEEL is not willing to make the necessary investment and commitment.” Because everyone in the room agreed that a success is needed in this arena, the following specific contaminant issues were discussed that if addressed, would receive active attention from the delegation to secure the necessary resources for implementation:

- *Zinc* – the primary problem remaining at the Bunker Hill Superfund cleanup
- *Creosote* – what’s the holdup at St. Maries and how can we help?
- *Selenium* – primarily in the mining wastes around Soda Springs, but an increasing problem in Central Idaho and in other states.

The session concluded with sharing examples of how INEEL could be of greater service to local communities as they struggle with issues related to water quality and endangered species. People have reported to our elected officials that interacting with Lab is just too complicated, whether it is with our legal department in negotiating confidentiality agreements or just looking for advice. Any effort to remove internal roadblocks and improve on the Lab’s follow through would be greatly appreciated by our Congressional delegation, as well as the public at large.

Two hours at the Idaho Department of Environmental Quality finished off the morning, with seven DEQ officials including Chief of Staff Jon Sandoval present to share their varied perspectives:

TMDL/Temperature Issues

- More sophisticated stream temperature models are needed to take into account the hyporheic zone.

- Remote sensing techniques are needed for improved data collection, particularly since the availability of temperature data across seasons and times is so poor.
- EPA is not actively engaged in research that considers the interplay in channel dimension/stream morphology. (One individual in Umatilla, OR is testing some new model ideas, however).

TMDL/Rapid Bioassessments

- Great variability exists in these assessments, from natural factors beyond our control to deviation in testing methods and interpretation of data.
- Each agency has incredible pride in their data and do not always readily share.
- A uniform method of establishing stream viability and overall health is greatly needed in the West. An outside party should at least validate methods and normalize results.

Groundwater-Surface Water Interactions

Source water assessments are now being conducted in areas that are being designated by IDWR as groundwater protection areas. Wellhead Protection Plans will be written by DEQ with 3, 6 and 10-year goals. Not only will the flow to the wellhead be characterized, but all potential contaminants will be described, including nitrates, selenium, PERC, and added salinity from residential softwater systems. Challenges facing water users and municipalities include:

- Groundwater modeling in great need of improvement (current data on 5 km grid that are inadequate for the need).
- 290 public water systems in Idaho must collect data by May 2003, then move to a voluntary protection effort. The Idaho Association of Cities may need our help.
- Big questions whether aquifer recharge programs being contemplated by IDWR would actually violate protection rules by potentially impacting existing water quality.
- Land application of highly organic wastewater from dairies and food processors is a potential problem, so an increase in new permits is anticipated. However, there needs to be a way to measure nitrogen contributions from land applications (rate of de-nitrification, etc.) given that flow and concentrations are hard to measure during the fall and winter months when processors apply their wastewater to fields. Food processing companies may be willing to assist financially.

Air Quality/Odors from Livestock and Food Processing Operations

More discussion ensued about the need to address odors that may violate provisions of the Clean Air Act and Land Application regulations. High levels of sulfides and concern for those with allergies were mentioned as reasons to improve measurement efforts. Could INEEL help with meteorological monitoring of field burning in N. Idaho?

Acid Mine Drainage/Mining Concerns

The group discussed how increased public concern with metals and contaminants from abandoned mines has virtually made the economics of small mining infeasible in the U.S. today. One conclusion offered was that a more intelligent risk assessment approach is needed that does not use EPA's "compounding conservatism" as the rule.

Observations on Working with the INEEL

- With respect to clean up and stewardship of contaminated sites, there was recognition that federal agencies involved with sites are taking FIVE different approaches to the problem. *Get on the same page*, was the recommendation.
- Frustration was expressed that agencies want a cookie-cutter approach that simply will not work in all circumstances and settings.
- The state really isn't sure of INEEL's expertise or who to contact for certain assistance. Contracting with universities isn't always timely as they work on a different time frame, so working with the INEEL scientists might make sense. One suggestion: Establish a statewide Scientific Advisory Board with members from agencies, universities and industry that launches ideas and coordinates research among interested parties (see Pennsylvania as an example).

Following the lunch break, the group journeyed to the Idaho District office of the U.S. Geological Survey where we met with District Chief Derrill Cowing, Groundwater Specialist Dave Clark and Idaho CAB Chair Stan Hobson. Following our introductory remarks, the GS personnel agreed that communities need impartial help with the science that goes into today's resource decisions.

- Of particular interest to USGS would be INEEL's involvement in modeling tributary input to the aquifer at the site. A proposal is now being prepared to demonstrate new mass measurement and microgravity techniques to show how the major tributaries contribute to the Snake Plain aquifer. Currently only 25-30 year old numbers are available that need to be updated.

Stan Hobson reiterated the need for INEEL to use peer review and impartial science as we make decisions to entomb facilities and handle wastes at RWMC. He emphasized the need to properly identify contaminants, determine their mobility and assess real risk.

The USGS said they wanted improved communication with INEEL, preferring a single point of access and having a single research liaison so as proposals surface, action can be taken promptly. INEEL needs to move from a "closed culture" to one where we always ask, "Who else needs to know?" Finally, they suggested these types of informal visits happen regularly so agencies can increase trust and share more information.

The Idaho Department of Commerce provided the next discussion venue with Deputy Director Karl Tueller and H. D. Palmer, Science & Technology Projects Coordinator, in attendance. The

initial topic was the Idaho Science and Technology Strategy that was finalized in December 2000. Dr. Billy Shipp serves as the Governor's Science Advisor and Chair of his Science and Technology Advisory Council, which has articulated the following vision:

Idaho will have, and be recognized as having, a vibrant technology-based economy that provides employment opportunities and high wage jobs for Idaho citizens. Increased emphasis on the application and use of science and technology in Idaho will continue to spawn new companies and industries, while contributing to the global competitiveness of its traditional industries.

The following individual strategies are those most relevant to the proposed Western Connections program that should be incorporated in the final design:

- Build, attract and retain a highly skilled technical workforce
- Invest in creating R&D excellence and promoting industry-university collaboration
- Establish a national and international image for Idaho as a leading technology center.

Tueller encouraged INEEL employees to be more open and more oriented to working with industry in creative ways. The idea of providing technical assistance to small communities is similar to a project already undertaken by BSU's Small Business Development Center that assists small manufacturers. Georgia Smith joined the group to report on an effort to develop a united message for improving Idaho's image (an Idaho "Brand") to grow its science & technology industries and to improve overall recruiting.

Representatives of four environmental organizations met at the offices of the Idaho Conservation League to share their perspectives on the INEEL and important environmental issues. Included were Rick Johnson, ICL Executive Director, Gary Richardson, Executive Director of Snake River Alliance, Sara Denniston of Idaho Rivers United and Bill Eddie, Idaho Office Director of the Land and Water Fund of the Rockies.

Rick, Bill and Sara all stated that they have relatively little knowledge of INEEL and its activities, with the exception of knowing that there is a significant waste problem above the Snake Plain Aquifer. They rely on Snake River Alliance to serve as their advocate for environmental protection and otherwise dedicate little of their organizational time to INEEL matters. Among the resource issues of their concern:

- Work on improving existing renewable energy technology, driving down cost, and making current technology more efficient
- Address heavy metals in the environment (e.g., selenium) and pursue more work in industrial microbial enzymes.
- Planning and zoning assistance is needed, particularly with siting dairies and CAFOs. Whatever technical expertise could be given to local communities would be welcome (e.g., methane digesters for dairy application)

Gary Richardson provided his courteous and candid views about his experience to date with the INEEL after 17 months in his current position. He has been positively impressed with the individual scientists he has interacted with at INEEL, but disappointed that when asked the big picture questions about waste cleanup, most are unable to explain the rationale for why some areas are getting remediated and others not.

He feels it is difficult to get information out of INEEL and wonders if there is real dedication to fixing the most serious waste problems at the site. He fears that the significant amount of money spent on “feel good” trips like the Journey is really “spin money” and that little follow through can be expected from us. A major concern of Gary’s is that DOE is still an agency committed to the continued creation of nuclear weapons, and that INEEL is attempting to keep itself whole until the next nuclear or weapons-related project arrives.

Friday, August 17: Pat Barclay, Executive Director of the Idaho Council on Industry and the Environment (ICIE), hosted a breakfast with several of her members present: Steve Johnson of the Idaho Grain Producers Association, Bob Bruce from CH2M Hill, and Suzanne Budge and Mark Johnson from the Gallatin Group consulting firm. Among the group’s remarks:

- Because the INEEL helped started ICIE and now is not even paying dues, there were some concerns about the degree of our sincerity in trying to strengthen relationships with industry in the state. While INEEL is viewed as a terrific resource, the lack of consistency in our efforts makes building relationships with us hard to accomplish.
- What INEEL must do is build and maintain multi-faceted, ground-level outreach efforts, which includes always making connections when one comes to town. Such consistency with one-on-one conversations will always be more effective than single “journey-type” missions that often seem to be looking for money from others. And by the way, minimize the use of Power Point presentations!
- Since Idaho Power Company’s relicensing efforts were brought up, there was a question as to why INEEL is not on the preferred vendor list for providing studies on hydropower? Teaming with others performing studies would be a win-win.
- Can INEEL be involved with peer review of the science involved in the salmon issue? A floating screen is being designed to keep fish out of irrigation diversions, so final testing and an independent engineering review might be appropriate for our involvement.
- A number of rivers are facing TMDL development challenges: Paradise Creek near Moscow where the town is being forced to meet unrealistic requirements; the Boise River where growth impacts need predicting; the Clearwater River at Lewiston where Potlatch needs to meet temperature thresholds that many doubt were met historically.
- The selenium studies involving the waste from five phosphate operations is just getting underway in Soda Springs. INEEL should consider helping DEQ with the scope of their studies and possibly serving on the technical advisory committee.

- INEEL involvement in the dairy issue and reducing nitrate-loading to groundwater made sense to the group. There is significant technology development underway that might be interesting to the Lab: the largest anaerobic digestion system in Idaho is operating at Simplot's feedlot at Grandview while cheese plants are experimenting with whey/cheese/manure incineration in test fuel mixtures ("Turds and Whey").

A 3-1/2 drive from Boise to Pocatello placed us at our last destination just in time for lunch: Idaho State University. Ed House, Chief Research Officer for ISU, hosted a luncheon followed by an open house that attracted over a dozen administrators and faculty. Among the positive highlights in the discussion:

- The INEEL collaboration with ISU in Biotechnology is a real success story with new faculty, external federal funding, and new campus-based doctoral programs.
- ISU is the strongest of any INRA institution in nuclear physics/science, and they are pleased to have INEEL folks working at the Idaho Accelerator Center, which is the most all encompassing of their INEEL partnerships.
- ISU also retains a highly regarded nuclear engineering program that is jointly developing with INEEL a 14-credit postbac certificate in applied nuclear energy. There are still 12-14 faculty at ISU who can contribute to nuclear science and engineering education, but ISU is concerned that INEEL is losing its best nuclear scientists and engineers.
- Other positive collaborations with INEEL have been in HVAC, GIS work under NASA grants, molecular biology (BRIN), and information security.

The group also shared several frustrations they have had in working with the Lab over the years which has made collaboration unnecessarily difficult:

- Too often INEEL scientists refuse to assist with proposal development or professional outreach and exchanges because they lack a "Charge #." Surely the lab can afford to set aside money targeted for professional exchange with its INRA partners? Attention also should be paid to maintaining sufficient reserves year-to-year so the uncertainty of project funding is reduced at the end of each budget cycle.
- INEEL employees who want to take ISU classes are having difficulty with being released from "work time" to take the necessary classes. If we revere life-long learning, shouldn't we make it easier for employees to get in their coursework?
- ISU retains its position that INEEL's desire to have a two-year "fast track" for managers to earn their Ph.D. while they are working full-time is a request that has "crossed the line" of reasonableness. Such a request compromises the professional standards that credible institutions must maintain. The required 18 credits of classroom work can be done if students are granted ten hours per week away from the workplace.
- Frustrations remain with getting international students into INEEL facilities and the professional insults that often come with the escort requirements.

3.5 Other Consultations

3.5.1 Dr. Jim Bauder

This Montana State University professor is focusing his research efforts on better understanding the cause-effect relationships of coal bed methane water once it reaches the surface. Because both EPA and local soil conservation districts require a standard by which to measure effects of saline and high SAR water on the landscape, Jim is studying the threshold levels for a variety of local soil types. It appears that certain soils may actually mitigate the effects of CBM water by acting as super-accumulators in a pretreatment filtration stage.

Jim believes that industry will continue to fund hydrologic monitoring studies and will play an active role in fine-tuning treatment technologies. However, there remains a gaping hole in our understanding of the long-term hydrologic implications to CBM development, particularly to the shallow alluvial systems.

3.5.2 David Schwarz

David is the chair of the Yellowstone River Conservation District Council that is developing the criteria upon which to determine stream and riparian impacts from CBM produced waters in Montana. The Montana Legislature empowered the local soil and water conservation districts to monitor the environmental effects of coal bed methane development so to keep monitoring and enforcement at the most site-specific scale possible.

3.5.3 Doug McChesney

Doug is Policy and Planning Manager, Water Resources Division, Washington Department of Ecology. The Department of Ecology is interested in having INEEL personnel visit in September in order to explore common research interests, particularly in the area of water management. The four priorities for the Water Division during this upcoming legislative session are as follows:

- Establishing and ensuring instream flow targets
- Dealing with the impacts of growing communities on water resources
- Improving water resource infrastructure
- Implementing an Aquifer Storage and Recovery (ASR) program

Doug concurred that groundwater-surface water interactions are still not well understood in the State of Washington, which is a significant obstacle to advancing a recharge program as envisioned by the agricultural interests. Washington has a "no impairment" water quality policy for their surface waters, which is challenging to meet.

3.5.4 Columbia Basin Contacts

Concurrent to the “Journey,” Gerald Sehlke in the Ecological and Cultural Resources Department has been consulting with several agencies and individuals in the Pacific Northwest to scope out Project 6.2.2 - A Systematic Evaluation for Optimizing Terrestrial, Riparian and Aquatic Habitats in the Pacific Northwest. Among those involved in development of this emerging Western Connections project have been:

- Andy Smith, Region 10 EPA, Seattle, WA
- Department of Lands in Idaho, Montana, Oregon & Washington
- Charlie Raines, Sierra Club, Cascade Conservation Partnership, Seattle, WA
- Doug McChesney, Washington Department of Ecology
- Mark Shaw, Bonneville Power Administration, Portland, OR
- Peter Paquet, Northwest Power Planning Council, Portland, OR
- Mary Lou Soscia, EPA, Portland, OR
- Mike Williams, USDA Forest Service, Lands Division
- Ray Brady, USDI Bureau of Land Management, Lands Dept.

Part II—Western Connections, a New Approach

4. BASIC PRINCIPLES

As those on the Journey were learning more about the West's most pressing and difficult environmental challenges, a report was released on the East Coast highlighting recommendations of more than 450 scientists and decision makers who participated in the first National Conference on Science, Policy and the Environment. The conference was sponsored by the National Council for Science and the Environment and was held on December 7 and 8, 2000, at the National Academy of Sciences in Washington, DC.

The conferees included individuals from more than 45 states and the District of Columbia, as well as Canadians, Europeans, and representatives of the INEEL. They came from a broad range of disciplines and perspectives in the natural sciences, social sciences, and engineering as well as the information technology and policy sectors. In other words, people attending this conference were similar to those visited by the INEEL scientists along their Journey and their conclusions were equally familiar:

- The breadth, depth, and diversity of the scientific specialties involved in successful environmental decision making make interdisciplinary and multidisciplinary approaches essential.
- Serious voids in scientific knowledge make resolution of current environmental problems and prevention of any future problems extremely difficult. Significant investment in environmental science and engineering is needed.
- The number of governmental, quasi-governmental, and nongovernmental organizations involved in environmental decision making increases the likelihood of serious voids or duplications in necessary programs. Identifying and coordinating both the missions and efforts undertaken by these organizations is identified as a top priority.
- There is a crucial need for periodic knowledge assessments that can provide scientists and policymakers with reliable and timely “state of the science” reports on the environment as a whole as well as on particular topics. Such assessments will require coordinated, multi-agency environmental tracking, monitoring, and inventory programs.
- Sound environmental decision making is dependent on an effective interface between scientists and policymakers based on reliable and timely “translation” of information and views between the two communities.
- A national environmental information infrastructure that will support intensified public information programs and environmental education and training initiatives (K-Adult) is fundamental to the success of such “translation” efforts.
- Science-based education about the environment is required at every level of society if the general public and their elected officials are to make informed, effective, and timely decisions.

- The integration of environmental knowledge, assessments, research, information, communication, and education is vital if our society is to achieve a requisite level of sustainability.

It is in INEEL's best interest to embrace these national recommendations as we design the Western Connections approach. By strengthening relationships with regional decision makers and following through on project commitments, the Lab can begin to restore public confidence in its ability to resolve complex environmental problems.

5. CONCEPTUAL STRUCTURE AND SERVICES

The complex environmental challenges identified by those visited on the "Journey" warrant the Lab's attention as the INEEL has committed itself to serving as a "national environmental science and engineering solution provider." As the Department of Energy's lead lab for Environmental Management, the INEEL has a clear responsibility to be an active partner in resolving the more difficult energy and environmental problems faced by the western states. Once properly organized and funded to serve as a coordinator of regional research, the Lab may effectively apply its scientific expertise and engineering capabilities to environmental problem-solving.

Western Connections is proposed as a cross-cutting, directed research approach that will be closely integrated with three major initiatives of the INEEL: Subsurface Science, Environmental Stewardship and Energy Resources. Initial research priorities have been identified on the Journey for these three areas (see Section 7), with a mix of funding sources anticipated for project implementation. In future years, even more participation by government, business and nonprofit sectors will be encouraged by establishing three support teams to a) set regional priorities, b) select sound project that maximize collaboration and c) ensure ongoing peer review. This future, three-step process is envisioned as follows:

- *Issues Identification Team:* Priorities for research would be established by a group of stakeholders representing agencies, universities, conservation organizations and industry from the various western bioregions. Team members would serve for staggered, three-year terms, thereby influencing three rounds of proposal submissions.
- *Project Selection Group:* Professionals recruited from throughout the region would form a selection team to evaluate proposal submissions and ensure the integrity of the research methodology being applied. Each team member would be assigned a "mentor" role for one of the successful projects, with semi-annual updates provided to the rest of the team. The extent and nature of the research collaborations would be of greatest importance to ensure an interdisciplinary, multi-institutional approach.
- *Peer Review Cadre:* Ongoing peer review should be goal of the Western Connections approach, with final research findings required to be submitted for review in order to receive a final 10% payment of funds. The peer review process used by the American Society for Mechanical Engineers (ASME) could serve as a model for this purpose.

A Western Connections Coordination Office should be established in at the INEEL to oversee the gradual implementation this research effort, with satellite offices opened in appropriate field locations (e.g., Alaska) to solidify and extend INEEL relationships. The following investigative, administrative and outreach functions would be the responsibility of program personnel:

- Continue to research the history of emerging environmental challenges in the region that merit Lab and INRA involvement in their resolution. Investigate how other labs and institutions, both inside and outside the region, may be addressing similar problems so to reduce duplication of effort and maximize accomplishments. Provide this information

annually to the Issues ID Team so to maximize their effectiveness.

- Annually prepare and administer a budget for Western Connections that provides base funding for office support and grant funding for selected research projects. Working with INRA and other institutions in the region, help the selected collaborative research proposals locate necessary matching funds from agencies, industry and private foundations.
- Ensure that data and information collected through Western Connections projects are properly managed and remain accessible through a new Geomatics Hub, funded for this purpose and formed with existing personnel. Providing information management and visualization services to those funded under Western Connections will be one more incentive for affiliating with this new institutional effort.
- Refashion the INEEL's current technical assistance program to make the service more accessible to those in need from the private and public sectors. Clarify in new written materials the nature of assistance that can legally be provided by the Lab and detail the steps required for gaining the desired scientific or engineering services.
- Provide a symbolic “brand” or signature for Western Connections projects that distinguishes them as highly collaborative, interdisciplinary and oriented to resolving complex energy and environmental challenges.
- Ensure that Western Connections is known for its quality and regularity of public outreach and unbiased educational services, which will be provided in cooperation with existing INEEL departments. As progress is made with Western Connection projects, the public will be kept informed through a network of western media outlets and a central network of interested agency, industry and organizational representatives.

5.1 Geomatics Hub

A new Geomatics team is being solidified within the INEEL to provide:

- Maps
- Software applications (Web-enabled and stand-alone)
- Predictive models
- Spatial data management
- Image processing.

A basic level of program support should go to the Geomatics Hub to provide Western Connections researchers and affiliates with the most advanced visualization and analytical services available. The Coordination Office will use the Geomatics staff to help integrate

research results by conducting region-wide analyses and developing visual representations of the progress being made with Western Connections investments.

5.2 Technical Assistance

One of the most common requests from local governments visited along the Journey was for affordable technical assistance from the INEEL. Few of those asking realized that INEEL already has such a program that provides 40 hours of free consulting to industry and small units of government, but this community service is not well advertised or understood. It is proposed that the program be “adopted” or more closely aligned with Western Connections to gain a higher profile among potential clients and to ensure that sufficient follow up is provided. The program should be evaluated for its previous effectiveness and for any needed design changes.

5.3 Educational and Outreach Services

The Western Connections program staff will have its greatest challenge in meeting the educational and outreach needs of the region. The INEEL has been criticized for its past performance in this area, so greater coordination is called for among those assigned to Western Connections work from Public Affairs, Communications and Educational Services. The following areas of outreach will be better integrated to maximize their effectiveness in reaching the various public interests:

- Develop written materials describing Western Connections and the various services provided
- Maintain a Web site highlighting the latest program activities, public meetings and research results. Link to key electronic media such as Headwaters News.
- Make semi-annual visits to key regional cities to reinforce relationships and build upon existing collaborations.
- Convene relevant public workshops, seminars and forums.
- Establish a new peer-reviewed scientific journal in cooperation with INRA or providing base support for existing regional journals, (e.g. the Intermountain Journal of Sciences published at MSU).
- Publish comprehensive listings of scientists and engineers (organized by discipline) at INEEL and at each INRA university (in cooperation with INRA)
- Support environmental education efforts in the region by developing curricula, providing outdoor science experiences (Action Teams), and getting involved in teacher training institutes.

6. COURSE OF IMPLEMENTATION

It will take many years of positive, on-the-ground results to see INEEL's Western Connections become the widely preferred avenue for conducting collaborative environmental research in the western states. In the near term, however, commitment of internal resources will be necessary to support INEEL and DOE-ID staff who wish to make Western Connections an efficient institutional mechanism for creative researchers in our Subsurface Science, Environmental Stewardship and Energy Resource Initiatives. Cooperation from the Inland Northwest Research Alliance (INRA) will be essential in encouraging principal investigators to focus on these three areas and to commit to multi-institutional involvement.

As our problem-solving capabilities and successes become more apparent, individuals from the government, private and nonprofit sectors increasingly will bring their collaborative research needs and resources to the INEEL. The capacity and influence of Western Connections will grow gradually as more requests for assistance are handled, more research proposals are submitted, and educational services are extended to a more diverse Western audience.

6.1 Integration into Lab Operations

INEEL leadership needs to demonstrate its commitment to Western Connections and to sustaining the regional relationships critical to its success. It will help if both DOE-ID and BBWI senior management publicly champion and institutionally advance the research performed under the Western Connections brand by:

- *Integrating Western Connections into the INEEL Institutional Plan.* It is important that regional problem solving become an inherent part of the organization and its institutional fabric. The Institutional Plan and associated planning documents should explicitly refer to Western Connections goals and objectives as a means of fulfilling our INEEL mission.
- *Integrating Western Connections into Discretionary Investment Funding Decisions.* Regional problem-solving needs to have a higher priority in the allocation decisions for discretionary funds (e.g. LDRD, SIF, GPCE).

6.2 One-Year Timeline

Development Phase (FY 02): Reinforcing the Relationships—Over the next fiscal year it will be critical to broaden the awareness of Western Connections and the new approach to regional issues it brings to the INEEL. Among the key activities proposed:

6.2.1 October-December 2001

Establish a Western Connections Coordination Office: The Ecological and Cultural Resources Department will provide the initial administrative services for Western Connections and build upon the relationships fostered through the Journey for Regional Relevance.

Form an INEEL-DOE Steering Committee: Key managers and technical leads from both the Lab and DOE-ID will be recruited to maintain the internal momentum started with the Journey and to

identify internal resources necessary to move forward with Western Connections. The Steering Committee should meet monthly through the first year to guide the overall research effort.

Engage the INEEL Fellows: Distinguished scientists will convene to brainstorm on the proposed Western Connections effort and provide perspective on the ten research projects outlined for initial pursuit.

Convene PIs to and INRA to Coordinate Research & Summit Planning: The ten principal investigators for the projects outlined in Section 7 will work together over the Fall months to advance their respective projects, help plan the winter summits and build upon multidisciplinary strengths.

Distribute the Final Journey Report: The entire contact list (see appendix) will receive a final version of this document along a schedule for followup winter summits in their local vicinity.

Establish a Web Page on the INEEL Site: The page will be oriented to those tied in to the Western Connections network and will include progress reports on research projects going forward under the Western Connections brand.

Assemble a Directory of INEEL Scientist and Engineers: A comprehensive listing of potential investigators with their academic credentials and publications has been requested by a number of universities interested in collaborating with the INEEL.

6.2.2 January-March 2002

Hold Topical Summits: A series of ten two-day summits will be held at cooperating universities throughout the region that will build upon the projects and conversations launched this year. Invited will be the 200+ Journey contacts (see appendix) as well as other stakeholders interested in Western Connections projects, but not reached during the initial visits. While the summits will focus on the subject matter at hand, time will be dedicated to discussing organizational aspects of Western Connections (e.g., communications, technical assistance, Geomatics, and fundraising).

Target cities, host universities and possible topics would include:

Coeur d'Alene	University of Idaho	"From A to Zinc"
Pullman	Washington State Univ.	Bioremediation of Creosote
Pocatello	Idaho State University	Status of Selenium Research
Boise	Boise State University	NW Conservation Priorities
Anchorage	Universities of Alaska	"Infrastructure on Ice"
Missoula/Butte	Montana Tech/UM	Clark Fork Superfund
Bozeman	Montana State University	Greater YellowstoneWORKS
Salt Lake City	University of Utah—EGI	Electric Transmission Models
Logan	Utah State University	Groundwater Quality
Laramie	University of Wyoming	CBM Produced Water

Initiate FY 03 Budget Discussions: As Western Connections momentum grows during this period, it will become apparent that line-item funding from Congress will be needed for INEEL

base funding and competitive research grants. Fiscal year 2003 budget alternatives will be developed and advanced using appropriate avenues.

6.2.3 April-June 2002

Begin Team Recruiting: Assuming that conditions are favorable for advancing an FY 2003 Western Connections research call, members will be recruited to form the Issues ID Team, Project Selection Group and Peer Review Cadre. Regional candidates will be identified from the Journey and Workshop circuit visits, although the teams may include individuals from outside the region.

Issue the First Western Connections Newsletter: A sufficient number of organizational elements should be in place by Summer 2002 to warrant the release of a Western Connections publication intended to maintain organizational momentum and help secure a permanent funding base. Reports would be made on each of the summits, with broad distribution intended throughout the country.

6.2.4 July-September 2002

Convene the Three Research Support Teams: Invited participants will convene in locations in or near Idaho Falls to design and launch the 2003 research agenda for Western Connections.

Out-Year Plan: Depending on the resources allocated to Western Connections, pilot-scale operations in fiscal years 2003-04 will lead to full-scale operations in fiscal year 2005.

6.3 Resource Requirements

Resources required for the initial design phase of Western Connections will include office space and administrative support (\$150K); funding for INEEL core personnel and their travel (\$485K); other INEEL personnel associated with relationship-building and conducting topical summits (\$315K); cost of recruiting and convening one session of each research support team (\$125K); and communication/outreach expenses (\$120K). This totals \$1.195M, although this figure should be considered a rough estimate only and is not budget quality at this stage. It does not include money currently allocated for the Community Technical Assistance Program funded elsewhere at the INEEL. If discretionary and programmatic funds are not re-prioritized to embrace these activities, then the costs are likely to be much greater.

7. INITIAL RESEARCH PROJECTS—CONCEPTUAL OUTLINES

7.1 Subsurface Challenges

7.1.1 Limiting the Impact of Acid Mine Drainage and Mine & Mill Wastes in the West

Problem Statement: Western states have been home to resource mining since the first major migrations of White Settlers. Despoliation of waters due to the production of Acid Mine Drainage (AMD) has been concomitant with mining activities. Many mining and milling activities produce residual sulfides that are transported to the surface or remain within a mine. Exposure of these mineral sulfides to air, water, and bacteria results in their oxidative decomposition that produces sulfuric acid and dissolved metals. The acid and metals often reach levels deleterious to ecological and human health. Exposure pathways for the metals and acid are through normal hydraulic processes. Mines intercept groundwater flow paths while surface residues are often found in drainage bottoms and surface water or are subjected to surficial weathering. The extent of contamination is enormous. Thousands of sites, hundreds of miles of waterways, and hundreds of square miles of land surface, and thousands of miles of underground workings are contaminated with AMD. For example the Clark Fork Watershed in Montana is the largest Superfund Site in the Country. The Site extends 125 miles in length. Presently there is no cure for AMD production. Hydraulic isolation and water treatment are used to mitigate impacts on water resources. However, both methods will require perpetual maintenance and operation. Primary issues at all sites include needs for:

- More cost effective technologies for treating high volumes of AMD
- Passive technologies to treat low volumes of non point source AMD
- Methods and tools to asses and predict the ecological impacts of AMD
- True remediation technologies that eliminate production of AMD at the source.

Geographic Scope: The entire Rocky Mountain West and Alaska.

Affected Parties (INRA States): Departments of Natural Resources and Environmental Quality in Montana, Utah, Idaho, Washington, and Alaska; Montana Bureau of Mines & Geology; Utah Geological Survey, Idaho Geological Survey; Bureau of Land Management—state offices; Forest Service—state offices; U.S. Geological Survey, Denver office.

INEEL Personnel (for example only): Paul Wichlacz, Biohydrometallurgy, Ecological Resources (PI); Karl Noah, Engineer, Biotechnology; John Beller, Mining Engineer, Ecological Resources; James McCarthy, Hydrology, Geosciences Dept.

Potential Collaborators: Universities—University of Montana, Montana State University, Montana Technical College, University of Idaho; tribes—Coeur d’Alene; industry—Hecla Mining Company and Coeur d’Alene Mining Co., both in Coeur d’Alene.

Funding Potential: Affected states (personnel, data resources, equipment, some cash); federal agencies may contribute (BLM, EPA, DOE); and congressional language submitted by Senator Crapo has funds that could be used in this area. An appropriation should have widespread political support. Note: INEEL is receiving minor funding from EPA (~\$30,000) to conduct a tracer study on the Bunker Hill Mine.

Project Description: Treatment and abatement of acid discharge associated with mining.

- Using the Coeur d'Alene mining district as a "test bed," develop engineering designs and protocols and associated technologies to advance the state of the art for point and nonpoint source treatment of AMD.
- Using the Clark Fork (Mt) and Coeur d'Alene (Id) River systems as models develop measurement and analytical methods for determining the environmental impact of AMD on a watershed basis.
- Initiate a fundamental R&D program to understand the biogeochemical basis for AMD production with the goal of elimination of production at the source.

INEEL's Role: Program integrator and technical lead in biohydrometallurgy and water treatment.

Co-investigators: Several universities and ID and MT Departments of Environmental Quality.

Rationale for Western Connections Program Affiliation: This issue warrants INEEL involvement as it is regional in scope, involves both scientific and engineering expertise that we have in-house, and has long-term implications for involvement. Relationships with a variety of agencies and institutions would be strengthened.

7.1.2 Reducing the Impact of Zinc on the Western Environment

Problem Statement: Abandoned mines in the Coeur d'Alene basin have resulted in significant heavy metals contamination in streams and rivers of the region. The focus has been removing lead due to the human health risks. However, zinc may have the largest impact of all the metals to the environment in the Silver Valley. In places it exceeds EPA standards and in some instances the levels approach the maximum amount dissolvable in water. Issues that need to be resolved include:

- Effective methods for analyzing for zinc
- Understanding the toxicological effects of zinc on the environment
- Effective methods for removing zinc from water
- Effective methods for hydraulic isolation of source terms
- Effective methods for keeping zinc from leaching out of sediments.

Geographic Scope: Northern Idaho, benefits to Eastern Washington.

Affected Parties: Silver Valley Natural Resources Trustees; State of Idaho Department of Environmental Quality; Coeur d'Alene Tribe; Environmental Protection Agency.

INEEL Personnel: John Beller, Mining Engineer, Ecological Resources (PI); Karl Noah, Engineer, Biotechnologies; Paul Wichlacz, Biohydrometallurgy, Ecological Resources; James McCarthy, Hydrology, Geosciences; Nancy Hampton, Ecologist, Ecological Resources.

Potential Collaborators: Universities—University of Idaho, Dr. Roy Mink; tribes—Coeur d'Alene; industry—Hecla Mining, Coeur d'Alene, Matthew Fein; agencies—State of Idaho Division of Environmental Quality, Geoffrey Harvey.

Funding Potential: Affected states (personnel, data resources, equipment, some cash); federal agencies may contribute (EPA); congressional appropriation should have widespread political support.

Project Description:

- Initiate fundamental research to understand mechanisms for zinc dissolution and affects of organics and inorganics on it solubility. Develop methods for analyzing and determining the form of dissolved zinc.
- Tying into existing treatment operations (Success Mine) within the Coeur d'Alene Basin to develop standard methodologies for removing zinc from mine drainage. Develop innovative methods for limiting redissolution of zinc. Establish engineering designs and protocols and associated technologies.
- Initiate a detailed analysis of the paths and affects of zinc in the environment focussing initially on aquatic ecosystems within the Coeur d'Alene basin.
- Initiate tracer studied within the within the Bunker Hill mine to better understand the hydrology and to focus on developing methods for hydraulic isolation of the source term.

7.1.3 Limiting Water Contamination by Selenium from Mine and Mill Operation Residue

Problem Statement: Resource extraction using mining has been a traditional industrial activity in the West. Most major mining activities have been directed toward recovery of a wide variety of metals (Cu, Zn, Au, Ag, Pb, etc). Mining exposes sulfide minerals to water and microbes resulting in the production of Acid Mine Drainage (AMD). Acid mine drainage is often toxic because it can be rich in toxic metals and be very acidic. Therefore, most protective measures for water produced from mineral extraction practices has been directed toward AMD prevention and treatment. Recently, it has been observed that Selenium (Se) is often associated with waters emanating from mining areas. Selenium, like many elements, is a nutrient at low concentrations and toxic at higher levels. The discharge standard for Se in water in Idaho is presently 5 parts per billion (ppb). Generally, Se is found associated with a type of shale rock that is ubiquitous throughout many Western States (ID, MT, UT, WY). The shale is deposited on the surface of the

land and must be removed to access mineral values beneath them. Removal of the shale exposes it to weathering conditions and results in leaching of Se as Selenate and Selenite, which are soluble forms of the element. Recent surveys have revealed that Se is being released in waters at levels requiring treatment from a variety of operating and closed mining sites across the region. In Idaho virtually every mine waste dump is a suspect as a source of polluting levels of Se. Technical solutions to the problem are twofold: (1) stop production at the source by hydraulic/biologic isolation of the source material or inhibition of production at the mineral; and (2) treatment or disposal of contaminated water. A greater understanding of the ecological impacts and biogeochemistry of Se would likely benefit standards setting and reveal alternative methods for disposal and treatment.

Hydraulic isolation and inhibition of production are promising areas for mitigation of Se leaching. However formidable challenges exist in engineering hydraulic barriers in very steep reaches and harsh weathering conditions. Inhibition of production at the mineral is the likely the best solution. However, very little is known about the mechanisms controlling release of Se under natural conditions. Presently, treatment of Se laden water is not achievable using conventional mine water treatment, is prohibitively expensive, and limited to areas with year-round road access and electrical connection. Chemical methods exist for Se removal, however they can not reduce Se to the low-levels required for drinking water standards (5 ppb). Ion exchange has also been used for Se removal, but the resins become quickly saturated with sulfur as Se is a sulfur analog and is usually found in high sulfur environments. These limitations preclude mining operations to meet discharge standards. Many abandoned mining sites are remote small sites requiring passive low/no maintenance systems, which are not presently available. Research is ongoing at the University of Idaho and Montana Technical College on methods for treating water containing low concentrations of Se. Little is known about the biogeochemistry of Se. The reliability of predictions of the fate and transport of either land disposed or injected Se is unknown. Discharge to the environment will require a greater understanding of the fate and transport of Se under a wide variety of conditions. Presently the Forest Service is investigating Se uptake rates in a wide variety of plant species.

Based on current treatment methods and ongoing research, areas for improvement are:

- More cost effective technologies for treating high volumes of Se bearing water
- Passive technologies to treat low volumes of non point sources
- Methods and tools to assess and predict the ecological impacts of Se bearing waters
- True remediation technologies that eliminate production of Se at the source.

Geographic Scope: The Rocky Mountain West.

Affected Parties (INRA States): Departments of Natural Resources and Environmental Quality in Montana, Utah, and Idaho; Montana Bureau of Mines & Geology; Utah Geological Survey, Idaho Geological Survey; Bureau of Land Management—state offices; Forest Service—state offices.

INEEL Personnel (for example only): Paul Wichlacz, Biohydrometallurgy, Ecological Resources (PI); Karl Noah, Engineer, Biotechnology; and John Beller, Mining Engineer, Ecological Resources.

Potential Collaborators: Universities—University of Montana, Montana State University, Montana Technical College, University of Idaho; tribes—Shoshone and Blackfoot; industry—Hecla Mining Company in Coeur d’Alene, FMC in Pocatello, Simplot in Pocatello, Monsanto in Soda Springs, Agrium U.S. Inc. in Soda Springs, Kennecott Copper in Bingham Canyon Utah, and COGEMA in Wyoming.

Funding Potential: Affected states (personnel, data resources, equipment, some cash); federal agencies may contribute (BLM, EPA, DOE).

Project Description: Treatment and abatement of acid discharge associated with mining.

- Working with impacted business use the Soda Springs mining district as a “test bed,” develop engineering designs and protocols and associated technologies to advance the state of the art for point and nonpoint source treatment.
- Using Grouse Creek system as a model develop measurement and analytical methods for determining the environmental impact of Se on a watershed basis.
- Initiate a fundamental R&D program to understand the biogeochemical basis for Se leaching with the goal of elimination of production at the source.

INEEL’s Role: Program integrator and technical lead in biohydrometallurgy and water treatment.

Co-investigators: Several universities and ID and MT Departments of Environmental Quality.

Rationale for Western Connections Program Affiliation: This issue warrants INEEL involvement as it is regional in scope, involves both scientific and engineering expertise that we have in-house, and has long-term implications for involvement. Relationships with a variety of agencies and institutions would be strengthened.

7.1.4 Treatment of Nonaqueous Phase Liquids in Groundwater

Problem Statement: Organic liquids that are heavier than water are referred to as dense, nonaqueous phase liquids (DNAPLs). Examples of such liquids include chlorinated solvents, PCB oils, creosote, and coal tar. Because they are denser than water, DNAPLs have the potential to migrate to great depths below the watertable. Organic liquids that are lighter than water are referred to as light, nonaqueous phase liquids (LNAPLs). Examples of LNAPLs include gasoline, jet fuel, and heating oils. LNAPLs tend to accumulate above and slightly below the watertable.

St. Maries, Idaho Creosote site is immediately adjacent to, and south of, the St. Joe River in the city of St. Maries, Idaho. Currently, the east side of the property contains the log-sorting and -peeling operation and the remainder is used for log storage; however, all processes using

creosote ended in 1964. However, from 1939 through 1964, the site was used for peeling and treating logs to be used for poles. The bottom portion of the poles were treated by soaking in large butt vats filled with creosote, a wood preservative containing 80% polynuclear aromatic hydrocarbons (PAHs), to prevent the poles from rotting once installed into the ground. The butt vats were located approximately 50 to 75 feet from the bank of the St. Joe River. Historically, as the treated poles were loaded onto rail cars by the stiff arm, creosote dripped onto the soil around the butt vats and rail cars. If several cars were loaded at once, poles would drip creosote onto the soil beneath the rail line.

EPA issued a Unilateral Administrative Order in January 1999, under CERCLA authority to PRPs for removal of creosote contaminated soil and debris on the bank of the St. Joe River that was causing a discharge to the river. EPA also required PRPs to conduct a site investigation in order to characterize soil and ground water contamination in and around the area of the former wood treating facility. Approximately 200 tons of contaminated soil and debris were removed from the riverbank in February 1999. EPA is presently evaluating site data to determine what additional cleanup actions may be necessary.

During a site reconnaissance conducted by consultants for the property owners on 20 November 1998, minor staining on the surface of the site was observed. Severe soil staining, a noticeable odor (as creosote), and a product sheen were noted along the bank of the river. The product sheen was observed in the river as well. The city of St. Maries was notified and the city also reported the site to the National Response Center.

Geographic Scope: The site is relatively flat and consists of log decks and haul roads between decks. The site is approximately 400 ft x 600 ft and abuts the St. Joe River. The edge of the site that forms the bank of the St. Joe River consists of various fill materials, including concrete, treated poles, scrap metal, and other debris.

A site reconnaissance trip was conducted by consultants for EPA on January 7, 1999. Six samples were collected: four samples from the exposed river bank and two surface water samples along the river in the areas where creosote appeared to be seeping from the river bank into the St. Joe River. The sample results revealed 18 semi-volatile organic compounds (SVOCs) at estimated concentrations ranging from 530 to 24,000,000 mg/kg in the surface soil and 17 SVOCs at estimated concentrations ranging from 2 to 560 mg/L in the surface water. During a walk-through of the site, on February 11, 1999, consultants for EPA observed a sheen on the river and a noticeable odor coming from the river.

The St. Joe River is part of the Coeur d' Alene Lake basin, which supports the spawning of the federal-listed threatened bull trout (*Salvelinus confluentus*). The bull trout migrates up the St. Joe River past the St. Maries Creosote site and finally into the St. Maries River. The St. Joe River within 15 miles downstream of the site is a migratory pathway and feeding area critical to anadromous fish species. The St. Joe River is also used as a source of drinking water, commercial food crop irrigation, and livestock watering.

Affected Parties: City of St. Maries, Idaho; EPA; citizens of the city; water users in and around the city; Native American tribes.

INEEL Personnel (for example only): Paul Wichlacz, INEEL Consulting Scientist; Ken Moor, INEEL Advisory Scientist.

Potential Collaborators: Universities—University of Idaho; tribes— Kootenai, Nez Perce, Coeur d’Alene; industry—B. J. Carney and Company.

Funding Potential: EPA Technical Assistance Program, Congressional appropriations, potential contributions from industry and information sharing also expected from more engaged companies.

Project Description: INEEL personnel have visited the city of St. Maries to determine if technical assistance could be provided relative to advanced technology for characterization and clean-up of a CERCLA site located within the city limits. The meeting was attended by the Mayor of St. Maries (Ernie Pendell); County Commissioner, Jack Buell; City Council Member, Ed Spooner; ID DEQ representative John Sutherland; as well as Jeff Allen, Mary Hasenoehrl, and Sarah Bigger of Senator Crapo’s Office. Paul Wichlacz represented the INEEL.

The meeting consisted of information exchange regarding what is known about the site and INEEL capabilities (NOTE: we have worked on at least 2 creosote site characterizations for EPA in the recent past) and a visit to the St. Maries Creosote site. Preliminary observations indicate that the site is not well characterized and that little analysis has been done on the data that have been collected. It is possible that a large DNAPL source term is responsible for the creosote in the river bottom and that they are not from historical direct pollution of the river.

INEEL’s Role: The INEEL will provide technical assistance to verify and validate the site characterization data, and planning support to promote selection of technical alternatives adequate for resolving the creosote contamination problems. As appropriate, the INEEL will contribute information and knowledge about particular technologies that may bear on the creosote problem, including bioremediation and DNAPL remediation and separation technologies.

Co-investigators: University of Texas (co-patent holder for SEAR-NB technology); University of Montana, Butte (composting of creosote contaminated soils); University of Oklahoma (Millford Tool site).

Rationale for Western Connections Affiliation: This issue warrants INEEL involvement because it extends the existing knowledge and relationship bases previously acquired with the City of St. Maries, and honors our pledge to the city and to the congressional delegation for INEEL Community Assistance. Relationships with agencies and institutions would be strengthened, and it will provide an excellent opportunity to demonstrate the INEEL’s multidisciplinary capability for comprehensive assessment of technical, environmental, and economic data, and their integration in effective decision making processes.

7.1.5 Understanding the Surface-Subsurface Interactions of Contaminants in the Clark Fork Drainage, Montana

Problem Statement: As a result of open-pit and underground mining operations in the Clark Fork Drainage, groundwater, surface water, and river sediments have been contaminated. The legacy of this mining is that indefinite active remediation of the groundwater may be required in order to protect the aquifers and surface waters in the drainage. This active remediation is extremely costly and subject to failure that could threaten the area water resources. A failsafe, passive, long-term remedial design is needed for both short and long-term water treatments. In order to make cost effective decisions for both the short and long-term management of the watershed, it is necessary to better understand the groundwater flow, chemical, and biological systems.

Geographic Scope: Clark Fork watershed in Montana (with downstream benefits to Idaho).

Affected Parties: Montana Department of Natural Resources and Conservation; Montana Department of Environmental Quality; The Environmental Protection Agency; Federal Energy and Regulatory Commission; U.S. Fish and Wildlife Service; Montana Bureau of Mines & Geology; Montana Bureau of Land Management; U.S. Geological Survey; Clark Fork Coalition; ARCO.

INEEL Personnel (for example only): James M. McCarthy, Geosciences (PI); Larry C. Hull, Consulting Engineering, Geochemistry; Joel M. Hubbell, Advisory Scientist, Instrumentation Technologies; Robert Starr, Advisory Scientist, Geosciences.

Potential Collaborators: Universities—University of Montana (Dr. John Moore, Environmental Geochemist), University of Montana (Dr. William Woessner, Hydrologist), Montana Tech (Dr. Ted Duaime, Hydrogeologist), Montana Bureau of Mines and Geology (Dr. John Metesh, Hydrogeologist); tribes—N/A; industry—ARCO; agencies—State of Montana (DEQ, Keith K. Large).

Funding Potential: Affected states (personnel, data resources, equipment, study grants); federal agencies may contribute (BLM, EPA, DOE); congressional appropriation should have widespread political support; contributions from industry.

Project Description: The objective of this project is to develop a long-term remedial system that requires minimal active remediation of either the groundwater or surface water. Major components to the project would include:

- Development of a groundwater model to improve understanding of the groundwater-surface water interactions in the vicinity of the Berkeley Pit and the Upper Clark River.
- Development of a geochemistry model to improve understanding of the subsurface chemistry and predict the evolution of the subsurface chemistry.
- Development and implementation of a long term monitoring plan specifically design to support the models for improved understanding of the flow and geochemical systems.

- Investigate the potential for developing and implementing a passive treatment system for the water that will eventually move through the Berkeley Pit to downgradient aquifers and the river. Optimistically, this would be an alternative to the commitment to an active treatment system with no end point. At a minimum, it would compliment the active treatment systems and perhaps provide a safety net in case of system failure. Major issues to be addressed include:
 - Reactive barrier technologies – emplacement, effectiveness, maintenance
 - Technologies to focus the groundwater to the reactive barrier (funnel and gate system)
- Investigate the potential for developing and implementing passive systems to address streamside tailings issues and the TMDL issues
- Investigate the potential for developing and implementing a passive treatment system for the water moving downstream from the Milltown dam.

This is a large-scale multi-disciplinary project that cannot adequately be addressed by any one company, university, or state agency. The INEEL is a large Department of Energy National Laboratory with scientific and engineering expertise covering many disciplines and the potential to collaborate with universities and laboratories throughout the world if necessary. Collaboration between the Montana scientists and engineers who have been studying this problem for many years and the INEEL or other scientists with different experience and expertise would produce a project team that could make great progress towards developing a successful passive remediation solution.

This issue is regional in scope and the solutions could be implemented in many similar sites around the country and the world. Participation in the project would allow the INEEL to strengthen relationships with a variety of regional agencies and institutions. The scientific and engineering expertise at the lab could be focused on an important problem for the state and people of Montana and should be affiliated with the Western Connections program.

7.2 Environmental Stewardship

7.2.1 Contaminants in the Arctic Environment: Baseline and Trend Monitoring for Ecological and Subsistence Resources

Problem Statement: Although many consider Alaska to be “pristine,” in fact there are many sources of environmental contaminants scattered throughout the state. These include active and inactive military sites, sites formerly used by AEC/DOE, and sites associated with extraction industries such as oil and gas production and mining. Contaminants range from toxic organics to heavy metals to radionuclides, and many of these contaminants have the potential to enter the food web—a significant problem especially where subsistence lifestyles are practiced. Accurate assessment of the transport and fate of these contaminants in the environment, and of the resulting effects (real or potential) to humans or to ecological resources requires the development and implementation of defensible, scientifically-based monitoring programs that can be conducted on a local or regional scale.

Geographic Scope: Throughout Alaska, focusing on areas near industrial or defense activities.

Affected Parties: Alaska Department of Natural Resources, Alaska Department of Environmental Quality, Alaska Department of Fish and Game, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, U.S. Forest Service, Department of Energy, Department of Defense, local villages, Native American groups and Native Corporations, Petroleum Industry, and Mining Industry.

INEEL Personnel (for example only): Greg White, Ecologist, Ecological and Cultural Resources; Charles Thomas, Engineering Fellow, Fossil Energy Technologies (PI).

Potential Collaborators: Universities—University of Alaska System; tribes—various regional corporations; industry—Alaska Oil and Gas Association (M. Crockett), Phillips Alaska (J. Hegna), BP Alaska (G. Snodgrass), Alaska Mining Commission.

Funding Potential: State of Alaska (personnel, data resources, equipment, some cash), U.S. Department of Energy, U.S. Department of Defense, other federal agencies (BLM, EPA, USFWS), congressional appropriations, industry contributions (information sharing also expected from more engaged companies).

Project Description: Alaska provides numerous and varied opportunities for the INEEL to contribute in the area of baseline and trend monitoring. To be able to fully assess these opportunities, and to respond to the appropriate opportunities, it is important that the INEEL expand its presence in Alaska. The best way to accomplish this is to establish a permanent office in Anchorage staffed with personnel knowledgeable in Alaska's needs and in the capabilities the INEEL has that can help satisfy those needs. It is therefore recommended that the INEEL open a small office in Anchorage that will serve as the focal point for matching the technologies and experience available at the INEEL with these needs. Examples of general areas of opportunities in Alaska that will be pursued by this office include:

- *A priori* establishment of baseline conditions: Petroleum production at Prudhoe Bay was developed without first determining an environmental baseline – i.e. monitoring water, air, vegetation, etc. for contaminant levels or symptoms of contamination. Measurements taken after development began therefore have no baseline against which to compare. This often makes it impossible to determine the actual contribution to contaminant levels or effects that is due to petroleum development.
- Native American groups in rural Alaska that maintain a subsistence lifestyle are concerned with the potential for water contamination from a mine proposed for an area upstream of their primary fishing grounds. They are interested in developing a monitoring program and recognize the need for establishing baseline conditions prior to the opening of the mine.
- Many rural communities located near former military sites, and there is a general lack the confidence among these communities that the government has adequately mitigated contamination problems at these sites. Efforts are being made either to (1) have an independent organization such as the INEEL do independent assessments of these sites; or (2) develop the analytical capabilities necessary to do the assessment on their own.

- There are many sites in Alaska that are contaminated with organic chemicals. Environmental samples containing these contaminants often have holding time restrictions – i.e. analysis must be conducted within a specific time period following collection of the sample for the analytical results to be accurate. However, many of the contaminated sites are remote, and samples cannot reach the laboratory before holding times are exceeded. A need has been identified for the development of mobile laboratories that can operate in remote locations.
- Assessment of transport and fate of radionuclides and other contaminants originating in Russia. Defense activities of the former Soviet Union have left an enormous legacy in eastern and northern Russia. Many of the major rivers draining into the Arctic Ocean carry heavy contaminant loads, and there are concerns about the long-term ramifications of suspected disposal of radioactive wastes or the sinking of nuclear submarines in the Arctic Ocean. There is a need to model and measure the rates of transport of these contaminants to Alaska via the Arctic Ocean or the Bering Sea and their subsequent entry into subsistence food chains.
- Former AEC/DOE activities at Point Hope and Amchitka Island have left a legacy of radioactive contamination. Monitoring and modeling is needed of the transport of these materials through ecological systems.
- Atmospheric fallout studies conducted in the 1960s that assessed the movement of ⁹⁰Sr and ¹³⁷Cs through the lichen-caribou-human food chain are in need of follow up to assess the role of the Chernobyl accident and other releases from the former Soviet Union.

7.2.2 A Systematic Evaluation for Optimizing Terrestrial, Riparian and Aquatic Habitats in the Pacific Northwest

Problem Statement: The cumulative effect of a drastically expanding population and extensive resource use has been so great in the Pacific Northwest that many ecosystems have become highly degraded or fractured and a number of native fish, wildlife and plant species have declined to the point of bordering on extinction. Whatever the mechanism, if we do not soon address the cumulative affects of these impacts, the decline may become irreversible for some species. Therefore, the INEEL is working with a number of state and federal agencies and other stakeholder groups and individuals towards the protection, mitigation and restoration of critical terrestrial, riparian and aquatic habitats in order to protect or restore various species/populations.

Geographic Scope: The primary geographic focus is the Columbia River Basin, but also includes lands along the Pacific coast between the Canadian border and the Klamath River Basin, and the Puget Sound subbasins.

Affected Parties: Natural resources extraction and harvest industries (e.g., logging and mining), water users, state and federal land and water management agencies, tribes and general public.

INEEL Personnel: Gerald Sehlke, Advisory Scientist, Ecological & Cultural Resources; Janice Brown, Advisory Scientist, Ecological & Cultural Resources; Jake Jacobson, Advisory Scientist, Ecological & Cultural Resources; Randy Lee, Principle Technical Spec., Ecological & Cultural

Resources; James McCarthy, Hydrologist, Geosciences Dept.; Ron Rope, Advisory Scientist, Ecological & Cultural Resources.

Potential Collaborators: Universities—University of Idaho (Drs. Jay O’Laughlin and Maxine Dakins), Utah State University (Dr. David Stevens), INRA (Dr. Gautam Pillay), Idaho Water Resources Research Institute (Dr. Roy Mink); tribes—Any Pacific Northwest Indian tribe that wishes to participate, although the most likely tribes are those associated with the Columbia Basin Fish & Wildlife Authority (Umatilla Indian Reservation, Shoshone-Bannock Tribes, Salish Kootenai Tribes, Yakama Indian Nation, Warm Springs Reservation, Burns-Paiute, Kootenai Tribe, Spokane Tribe, Colville Reservation, Nez Perce Tribe, Kalispel Tribe, Shoshone-Paiute Tribe, and Coeur d’ Alene Tribe); industry—Clear Water Land Exchange in Orofino (Idaho), Western Land Exchange in Seattle, and Hammond Collier & Wade, Livingstone, Inc. in Seattle.

Agencies: This research is proposed as a collaborative effort between the Pacific Northwest Power Planning Council (the Council) and the primary federal land management (e.g., the USFS, BLM, USF&WS and NPS), federal water management agencies (e.g., BPA, Corps of Engineers, USBOR and FERC); National Marine Fisheries Service; and state land and fish and wildlife agencies for the four Pacific Northwest states (ID, MT, OR and WA).

Funding Potential: The primary funding source will be the Northwest Power Planning Council for the analyses within the Columbia River Basin, and the four land management agencies for analyses outside the Columbia River Basin.

Project Description: The intent of this research is to assist the Council and public land managers by developing a systematic methodology and framework for evaluating land/water assets and needs within the region and for addressing their management needs and goals. It will further provide the means to delineate and prioritize potential interagency boundary adjustments, adjustments to management plans, and land/water acquisitions to met those needs and goals. While the Council and each agency has its own specific mission and goals and needs, each has the general mandate to protect, maintain, or restore natural resources and species under their jurisdiction for present and future generations and to manage their resources in the most efficient and effective manner possible. The Council and each federal agency maintain a management plan that documents their primary land and water acquisition/management needs and goals, as have some of the states. Council’s goals and needs for the Columbia River Basin are outlined in its 2000 Council’s Columbia River Basin Fish and Wildlife Program (NWPPC 2000). Each federal land management agency’s land management goals and needs are tailored to individual management areas (e.g., individual forest, parks or refuge plans). These goals and needs are documented in area-specific management plans (e.g., USFS Forest Management Plans, BLM Land Management Plans, NPS General Management Plans and USF&WS National Wildlife Refuge Comprehensive Conservation Plans).

INEEL’s Role: The INEEL will conduct the program management, coordinate with the various key players, oversee work by the universities, and conduct many of the analyses. It is anticipated that much of the analytical work will be conducted by graduate students from INRA universities.

Co-investigators: Gerald Sehlke will be the PI; however, the full INEEL/INRA team has not been determined to date.

7.3 Responsible Energy and Transportation Development

7.3.1 Hydrologic Challenges in Western Coal Bed Methane Development

Problem Statement: Western states have been ill-prepared for handling the high volumes of water produced as a byproduct of bringing the methane gas to the surface. Concerns of all the states include:

- How to handle high volumes of low-quality, water that may have negative environmental impacts if kept on the surface (treatment technologies, management strategies, etc.)
- Cost-effective methods and protocols to evaluate reinjection options. Geologic formations that are acceptable for injection are not well mapped or understood.

Geographic Scope: Identified coal reserves in Alaska, Montana, Utah, and Wyoming.

Affected Parties: Departments of Natural Resources in Montana, Utah, Alaska; Montana & Wyoming Departments of Environmental Quality; Oil & Gas Commissions in Montana and Wyoming; Montana Bureau of Mines & Geology; Utah Geological Survey; Bureau of Land Management—Montana and Alaska state offices; U.S. Geological Survey, Denver office; Yellowstone Basin Soil and Water Conservation Districts; Coal Bed Methane Coordination Coalition, Wyoming.

INEEL Personnel (for example only): Charles Thomas, Engineering Fellow, Fossil Energy Technologies; (for example only) Jenn-Tai Liang, Advisory Engineer, Fossil Energy Technologies; Eric Robertson, Staff Engineer, Fossil Energy Technologies; James McCarthy, Hydrologist, Geosciences Dept.; Janice Brown, Advisory Scientist, Ecological & Cultural Resources.

Potential Collaborators: Universities—University of Wyoming (Drs. Larry Munn, Soil Scientist; Quentin Skinner, Watershed Management; and George Vance, Soil and Environmental Chemist), Montana State University (Dr. Jim Bauder, Hydrologist), University of Montana (Dr. William Woessner, Hydrologist); tribes—Northern Cheyenne (partnering on DOE-funded study with INEEL); industry—Nance Petroleum Corporation in Billings and Fidelity/WBI Production, Inc. in Sheridan, Wyoming.

Funding Potential: Affected states (personnel, data resources, equipment, some cash), federal agencies (BLM, EPA, DOE), congressional appropriation, and industry contributions (information sharing also expected from more engaged companies). Note: INEEL will be receiving \$300,000 from the DOE National Petroleum Technology Office (NPTO) for conducting an economic assessment of the coal bed methane potential on the Northern Cheyenne Reservation. Reinjection of produced water would be required, which is why the Montana Bureau of Mines and Geology is involved as a collaborator for ¼ of the contract. The FWP in place with NPTO for a September FY 2001 start of the project. The funding is from the DOE Office of Fossil Energy's Native American Program managed by NPTO.

Project Description: Step 1—Conduct the study that is being funded by the NPTO Native American Program. The project is outlined below.

Step 2—Develop a similar project in the state of Alaska with one or more of the Alaska Native corporations. Also, high potential for support by the NPTO Native American Program. Significant interest and motivation to move forward rapidly in Alaska was identified in the Alaska trip. The state of Alaska is requiring the issue of leases for coal bed methane development but the issues surrounding the environmental impacts and rules for development have not been developed.

Step 3—Develop a region strategy and financial support to assess the impacts of continued and expanding coal bed methane development throughout the region - Wyoming, Montana, and the likely expansion into Colorado and Utah as well as development in Alaska. The INEEL can provide the crosscutting connections between all the areas and identify the common issues and regionally unique issues and the options for managing them in the most environmentally acceptable manner.

Northern Cheyenne Coal Bed Methane Resource Assessment: Coal bed methane (CBM) development in the Powder River Basin is the fastest growing natural gas play in the United States. In Montana, the northern most extent of the Powder River Basin coal play is associated with the Northern Cheyenne Indian Reservation. Because coal bed methane production from tribal lands represents a significant asset, the Northern Cheyenne Tribe is eager to evaluate this important resource. However, if CBM gas plays are to be developed on tribal lands, a cost-effective and environmentally responsible management plan is essential.

The INEEL in partnership with the Northern Cheyenne Tribe, and in conjunction with the Montana Bureau of Mining and Geology (MBMG) and the Bureau of Indian Affairs (BIA) will conduct a complete analysis of the coal bed methane production potential for coal assets underlying the Northern Cheyenne Indian Reservation of Montana. Because of the environmental concerns associated with coal water production in Montana, special emphasis will be placed upon identifying environmentally acceptable and cost-effective methods for producing gas while managing potentially large volumes of water. Multiple water handling options will be reviewed within the context of the forecasted gas and water rates associated with the development of coal assets under Northern Cheyenne tribal lands. Production forecasts will be acquired via reservoir simulation and will be based upon assumed reservoir properties and an actual geologic description of the coal assets. Of the water disposal options to be assessed, water disposal by reinjection will be evaluated closely. The ultimate objective of the study is to determine which CBM development scenario and water handling option(s) maximizes the beneficial use of produced coal water and the economic return to the Northern Cheyenne Indian Tribe while minimizing adverse environmental impacts.

INEEL's Role: Step 1—The INEEL will lead the Northern Cheyenne project and perform the modeling and assessment of the coal bed methane resource, including the evaluation of water handling options, in collaboration with the David Lopez of the Montana Bureau of Mining and Geology. Kevin Raterman will be the Principal Investigator for the project.

Step 2—The INEEL, Charles Thomas, has initiated discussions with the NPTO of additional projects, similar to the Montana project, in Alaska with the appropriate native corporations that could also be funded by the Native American Program. The state agencies and groups in Alaska that were identified in the Alaska trip with particular interest and involvement in the coal bed methane issues will be contacted and collaborative efforts developed.

Step 3—The INEEL will proceed to develop a detailed plan for regional involvement in the coal bed methane issues based on the progress made in the projects discussed in Steps 1 and 2. The issues will be addressed on a broad collaborative front with the state and local agencies and interest groups in the region.

Co-investigators: Step 1—Montana Bureau of Mining and Geology (MBMG), David Lopez. MBMG is providing 25% of Dr. Lopez' support.

Step 2 and 3—To be determined but expected to include universities in the respective states involved, and state and federal agencies.

Rationale for Western Connections Program Affiliation: This issue warrants INEEL involvement as it is regional in scope, involves both scientific and engineering expertise that we have in-house, and has long-term implications for involvement. Relationships with a variety of agencies and institutions would be strengthened. It provides an excellent opportunity to demonstrate the INEEL's multidisciplinary capability for comprehensive assessment of technical, environmental, and economic assessment of natural resources and their development for mutual benefit of the region and nation. This demonstrated capability would have wide application in coal bed methane issues in Montana, Wyoming, Alaska, Colorado and Utah.

7.3.2 A Systems View of the Electric Transmission and Energy Planning in the West

Problem Statement: With the current power shortage throughout the West, there is a rush to cultivate new electricity sources. What will be the long-term social, environmental effects of these new sources. Are the new sources sustainable or short term? These are the questions that need to be answered before we plunge forward. The Western Governors Association (WGA) is tasked with understanding the effects of new power sources that are being proposed. There is a great deal of effort going on to answer some of these questions but almost all of it is coming from industry. The research will most likely be tainted in their favor. What is needed is a nonpartisan look at the problem. The INEEL is situated to coordinate and lead a diverse group of agencies and research institutes in looking at current electricity problem in the West. The INEEL could provide in resource modeling and decision support technology. The implications of this analysis could lead to important policy decisions affecting regional planning (e.g., use of coal gasification, power plant siting, transmission siting and improvements, environmental implications).

Geographic Scope: The primary geographic focus is the Western United States.

Affected Parties: State and Federal agencies, Industry and the general public.

INEEL Personnel: Gerald Sehlke, Advisory Scientist, Ecological & Cultural Resources; Jake Jacobson, Advisory Scientist, Ecological & Cultural Resources; David Shropshire, Consulting Scientist.

Potential Collaborators: Universities—Washington State University (Dr. Andrew Ford); industry—Electrical industry, gas and fossil fuel companies; agencies—Pacific Northwest Power Planning Council (the Council), Bonneville Power Administration, state and federal agencies from all the western states, EPA, Federal Energy Regulatory Commission.

Funding Potential: The primary funding source is most likely DOE where the Western Governors Association will be able to help secure funding.

Project Description: This is a large-scale multi-disciplinary project that cannot adequately be addressed by any one company, university, or state agency. The INEEL is a large Department of Energy National Laboratory with scientific and engineering expertise covering many disciplines and the potential to collaborate with universities and laboratories throughout the world if necessary.

INEEL's Role: The INEEL will conduct the program management, coordinate with the various key players, oversee work by the universities, and conduct most of the analyses. It is anticipated that much of the analytical work will be conducted by graduate students from INRA universities.

Co-investigators: To be determined.

Rationale for Western Connections Program Affiliation: This issue warrants INEEL involvement as it is regional in scope, involves both scientific and engineering expertise that we have in-house, and has long-term implications for involvement. Relationships with a variety of agencies and institutions would be strengthened.

7.3.3 Greater Yellowstone WORKS (Weaving our Resources, Knowledge and Systems across the Yellowstone-Teton Region)

Problem Statement: As Yellowstone and Grand Teton National Parks enter the new century, they face infrastructure repair and development costs of well over a billion dollars. How these dollars are invested has a direct impact on the Parks, the visitor experience, and the communities in the region that face their own issues of growth and preservation.

Geographic Scope: Greater Yellowstone Area includes parts of Idaho, Montana, and Wyoming.

Affected Parties: Department of Interior—two national parks; Department of Agriculture—seven national forests; Department of Transportation; Department of Energy; Environmental Protection Agency; Gateway Communities, e.g., Jackson, Wyoming, West Yellowstone; numerous nongovernment organizations; and visitors.

INEEL Personnel: Robert Nitschke, Science/Engineering Fellow, (PI); Janice Brown, Advisory Scientist, Ecological & Cultural Resources; and others yet to be named.

Potential Collaborators: Universities—Inland Northwest Research Alliance (INRA), including Montana State University (Western Transportation Institute), University of Montana, University of Idaho, and University of Wyoming; industry—various energy and transportation companies

yet to be named, and other Department of Energy laboratories yet to be named; and NGO'S—Greater Yellowstone Clean Cities Coalition.

Funding Potential: Department of Transportation, Department of Interior, Department of Agriculture, other federal agencies such as NASA, American Association of State Highway Transportation Officials, and numerous nongovernmental organizations such as the Turner Foundation. Note: Monies have been received from both the Department of Transportation and Department of Interior to initiate this work.

Project Description: The GY WORKS project is an effort by public and private sector interests to work together to better integrate their infrastructure development needs. These needs fall into the major system categories of transportation, energy, facilities and information. To accomplish this, the project will develop systems analysis methods and computer simulations that will evaluate and produce alternative scenarios for infrastructure development in Grand Teton and Yellowstone National Parks. The analysis will describe the relationships between infrastructures and use technical requirements derived from stakeholder values to produce tools for creating and analyzing infrastructure scenarios. The resulting system solutions will provide better utilization, reduced environmental impact, and improved information for economic decisions. This work will also be expanded to include Gateway communities.

INEEL's Role: The INEEL has the lead project management role for the project. The INEEL also is responsible for the development and implementation of the technical systems analysis.

Co-investigators: Yellowstone National Park is the primary interface with the park and park personnel, identifying and obtaining existing data sources, bringing the parks perspective to the overall project, identifying existing and planned changes to the park especially with regards to the infrastructures. YNP is also responsible for keeping park management and key personnel informed of the project status.

Grand Teton National Park is the primary interface with the park and park personnel, identifying and obtaining existing data sources, bringing the parks perspective to the overall project, identifying existing and planned changes to the park especially with regards to the infrastructures. GTNP is also responsible for keeping park management and key personnel informed of the project status.

Greater Yellowstone Clean Cities Coalition is the primary interface with regional stakeholders to help them understand the goals and objectives of the project and to ensure the views and visions of the stakeholders are embraced by the project. The GYCCC will also be responsible for studying governmental regulations and requirements associated with implementing a regional strategy.

Rationale for Western Connections Program Affiliation: This issue warrants INEEL involvement as it is regional in scope, involves both scientific and engineering expertise that we have in-house, and has long-term implications for involvement. Relationships with a variety of agencies and institutions would be strengthened. It provides an excellent opportunity to demonstrate the INEEL's multi-disciplinary capability for comprehensive assessment of the interrelationships of man-made systems and their impacts on the environmental sanctity of the nation's premier national parks and the regional economies of the gateway communities.

Appendix

Contact List

